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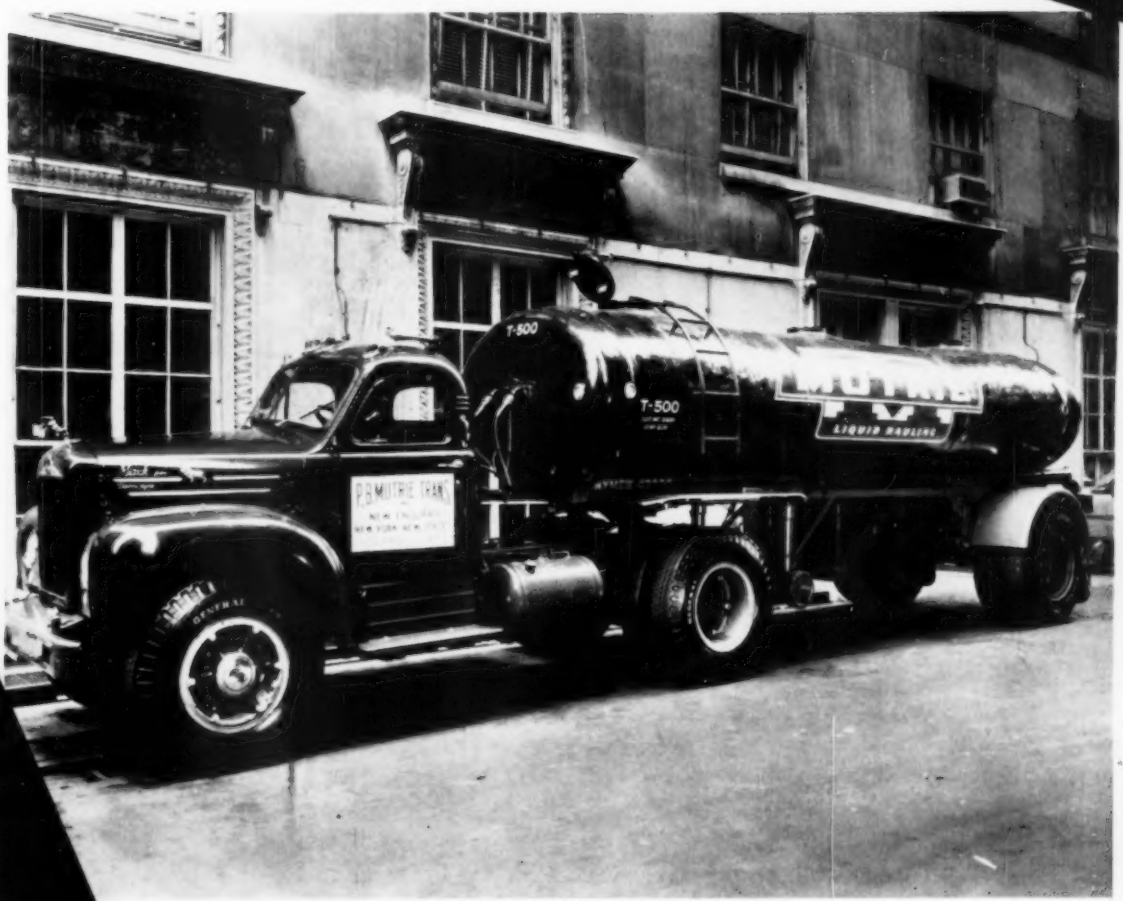
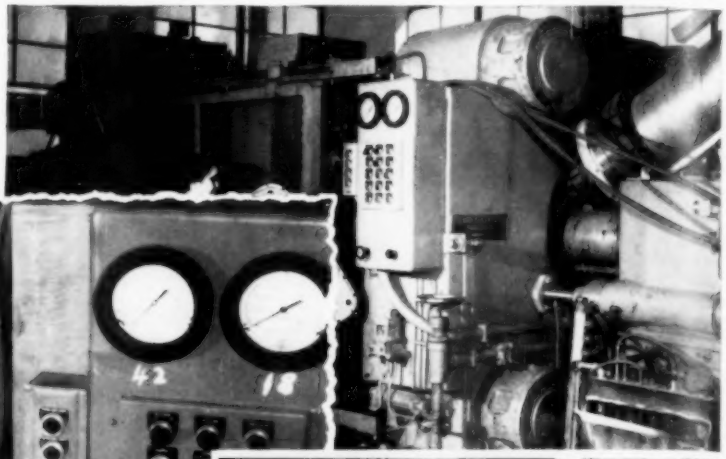


This 3400 gallon tank weighs nearly two tons less than a steel tank of the same capacity, needs no special lining for corrosion resistance, and could be easily repaired. It was made of Laminac Polyester resin with Fiberglas by Carl N. Beetle Plastics.

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

92 OUNCE PIECE MOLDED EVERY



65 seconds

With The W-S 300 Oz. Plastics Molding Machine

Photos, furnished by General Machine & Tool Works, show production-action shots in their modern Walled Lake, Michigan plant. Here you see an International Harvester inner door liner, molded of Styron, coming off the production line. This single unit piece weighing 5 lbs., 12 ounces requires 784 square inches of projected area. Its average thickness is .115 inches. It measures 27½ x 28½ inches and it's a flash-free molding.

Speed . . . economy and maximum production efficiency is what you get with every Watson-Stillman Plastics Molding Machine. Capacities from 1 to 300 ozs. They're the first choice of the industry. Write for literature covering Injection, Transfer and Compression Molding Machines.

W-S HYDRAULIC
ESTABLISHED 1848

THE WATSON-STILLMAN COMPANY
DIVISION OF H. K. PORTER COMPANY, INC.
153 ALDENE RD., ROSELLE, NEW JERSEY
Foreign Sales Representatives: OMNI PRODUCTS CORP., 460 Fourth Avenue, New York 16, N. Y.
Correspondents Throughout the World

JOURNAL

Vol. 9 November, 1953 No. 9

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The Society of Plastics Engineers Journal is not responsible for the views expressed by individual contributors. Copy for each issue should be received at The Security Bank Bldg., Athens, Ohio before the first of the preceding month.

DUREZ now presents a

HIGH DIELECTRIC PHENOLIC MATERIAL with improved molding characteristics

This new material may simplify your plans to improve products now in your line or to develop new ones.

One of the outstanding advantages of Durez 16274 (Natural) is the ability to maintain its electrical properties after immersion in water for extended periods.

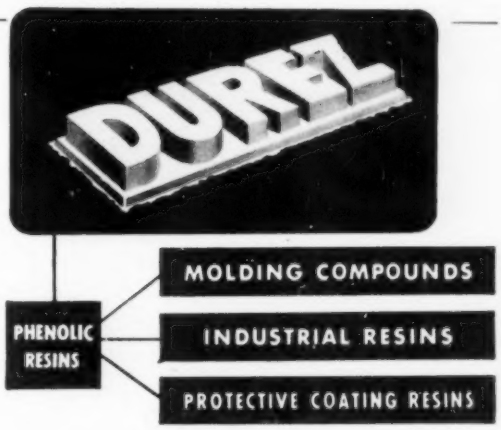
Low dissipation and low water absorption factors make it especially suitable for parts to be used under long exposure to high humidity. It is strong, dimensionally stable, and resistant to heat.

Durez 16274 has been formulated to provide better molding properties than existing electrical grade compounds. Its longer flow and faster cure offer new and interesting design possibilities. Available in plasticities suitable for compression or transfer molding, and is designed to meet the requirements of MIL-P-14 specification, Type MFE.

COMPLETE DATA ON DUREZ 16274 will gladly be supplied, and the consulting services of the nation's leading phenolics specialists are always available.

Write DUREZ PLASTICS & CHEMICALS, INC.
1111 WALCK ROAD, NORTH TONAWANDA, N. Y.

Member S. P. I. Committee on Large Plastics Moldings



PHENOLIC PLASTICS THAT FIT THE JOB

Your National Office

Report by the Executive Secretary to the National Council Meeting in Toronto, September 15, 1953.

Gentlemen, as you know, I have been at the National Office since July 20th. A great deal of my time, and that generously given by Mrs. Day, as well as the time of the staff, has been devoted to my finding out and learning the activities of the National Organization of the Society and the routine of the National Office. In addition I have tried to do some preliminary thinking on the several major problems facing the society. One of which is **increasing membership;** another is **putting the JOURNAL on a self-supporting basis; suggesting means of better organizing and giving direction to the activities of the various national committees of the Society; the relocation of the National Office;** and **determining what recommendations should be made as to whether or not an outside outfit should be given the responsibility of publishing the JOURNAL.** These are, of course, all very important problems; however, the problem that has been most time-consuming for me is, and will continue to be, the setting of my own house in order, so to speak. I feel that the society is now on the verge of substantial growth in every direction and with growth procedural changes will be necessary.

OFFICE SYSTEMS NEED MODERNIZATION

The office systems, bookkeeping and record-keeping of the National Office have been adequate for its past operation, but with very much more activity on the part of the Society will become too cumbersome and time-consuming to warrant their continued use.

In the National Office there are now four people on the Society's payroll: the Executive Secretary, the Editor of the JOURNAL, and two girls. During the months immediately preceding the conference it is necessary to employ a third girl, at least part-time, to help turn out the correspondence, press releases, invitations, etc., of the conference. With the systems now in use I have found it very difficult even with my present staff to keep current with the routine operation of the office. There are some reasons that may be only temporary causes; one of which was the time that was needed for me to learn my job; another is that I have reorganized the duties of the National Office staff, so that much of the routine and all other bookkeeping formerly handled by Mrs. Day is now taken care of by one of the girls. She, of course, had to be trained for this job also. Another has resigned to join her husband who has relocated. Again the training of a new person for her job was necessary.

Nevertheless, I feel that the present file systems, and record-keeping systems go a long way to explain the constantly threatening backlog of work. To give you some idea of the amount of work being done by the National Office, may I mention here that we have been using approximately $100.00 in postage every month. This probably represents about 5000 pieces of mail a month, considering our third class permit.

Now, all this, I feel, is primarily my problem since I am on the scene at least eight hours a day. It will be up to me, I am sure, to determine the solution. I do not believe it desirable to expand the staff at this time. Rather, I feel, the solution is a modernization of systems in the National Office.

THE CONFERENCE

As I see it, the second major job confronting me during the coming months is handling the details, and follow-up for the conference in January. While the local sections handle the organizing, staging, and conducting of the National Conference, it is estimated that the National Office's part in preparing for a conference takes half of the entire staffs' time between the months of September and January.

RELOCATION

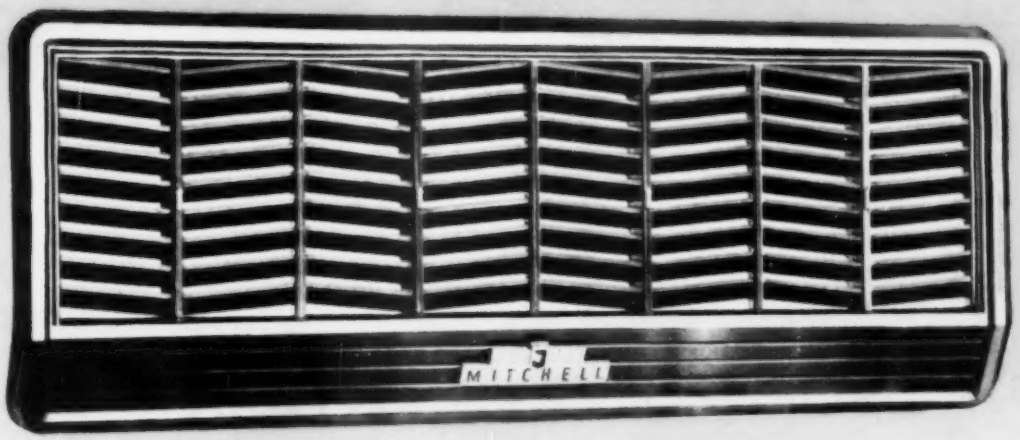
On the subject of relocation, my feeling is this; with these two time-consuming jobs ahead of me, I feel it would be most unwise for the National Office to attempt to move, establish itself in another city, and, at the same time, try to carry on the regular functions of the National Office; at least until after the National Conference in January. I, therefore, recommend that the council allow me more time in which to study the problem of relocation, with the goal of the National Council Meeting in January as the date for presentation of my affirmative recommendations on this subject.

INCREASING JOURNAL'S ADVERTISING

The National Council has declared the policy of the society to be that the JOURNAL's advertising be increased. I have talked, long and hard, with many on this subject of increasing advertising in the JOURNAL. For the September issue of the JOURNAL, advertising has represented better than 25% of the contents of the magazine. The same will be true of the October issue. If this ratio continues for the remainder of the fiscal year, the JOURNAL should break even. That is certainly our immediate goal. Roughly speaking it takes roughly nine pages of advertising per issue. Since this fulfills the present policy as set down by the National Council, I see no need at this time to consider turning the JOURNAL over to an outside firm for publication, thus necessitating sharing our income with outsiders. I, therefore, recommend that the subject of turning the JOURNAL over to a publications' representative be tabled until next year.

I do not mean to say that we have sufficient advertising contracts on hand to insure the JOURNAL's financial success. The advertising we have received so far, however, has been primarily voluntary with little or no solicitation on our part. I feel

(please turn to page 6)



Air conditioner movable louvers and frame
molded by Chicago Molded Products Corp., Chicago, Ill.

"FOUR SEASONS" SERVICE

From a Four-Way Grille of
BAKELITE PHENOLIC PLASTICS

TRADE-MARK

The Mitchell "Four Seasons" room air conditioner can work the year round . . . it cools air in summer, warms it in winter.

Its four movable louvers and their frame are molded of BAKELITE Phenolic Plastics to match this all-round service. They can be turned to direct the air in four directions. Frequent handling for adjustments won't hurt them. Heat, cold, and moisture won't affect their shape. Their colors are molded in—there's no applied finish to chip or peel. Their fine, clean lines reflect the efficient design and performance of the unit.

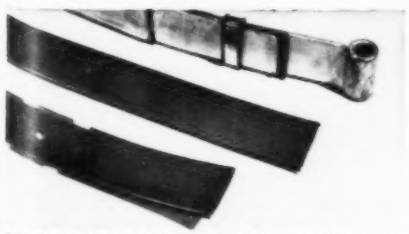
The name plate and concealed splash ring are also molded of BAKELITE Phenolic Plastic—demonstrating that this material can range from the purely decorative to the highly utilitarian. It is resistant to chemicals, oil, grease, vibration. It has excellent electrical properties when required. It comes in a variety of types to fit many different jobs.

These features of BAKELITE Phenolic Plastics may cut your production problems, bring more sales. Learn how they can be applied. Bakelite Company engineers will help. Write Dept. RU-43.

BAKELITE
TRADE-MARK
PHENOLIC PLASTICS

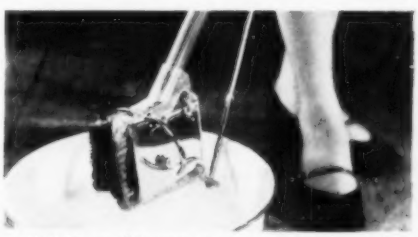
TRADE MARK

BAKELITE COMPANY
A Division of
Union Carbide and Carbon Corporation
UCC
30 East 42nd Street, New York 17, N. Y.
In Canada:
Bakelite Company (Canada) Ltd., Belleville, Ont.



SPRING PADS, injection molded of BAKELITE Polyethylene, separate spring leaves, keep dirt out, prevent metal contact. Give long service at low cost. Made by Spring Perch Co., Lackawanna, N. Y.

SALAD SERVICE molded of BAKELITE C-11 Plastic resists salad oil, fruit juices, washing in hot water. Production costs are low. Has good finish, impact strength. Made by Jim Robbins Co., Royal Oak, Mich.



BRISTLES on this sponge mop are BAKELITE Styrene Plastic monofilaments that retain stiffness, withstand soap and detergents, won't curl. Dirt can't penetrate. Made by Buff Products Co., Port Chester, N. Y.

Your National Office

(continued from page 4)

that with a minimum amount of solicitation on the part of the National Office, and if necessary, personal solicitation, sufficient advertising to break even will result.

The National Office has already mailed out approximately 150 promotional letters and circulation information on the JOURNAL to our advertisers and to a new list of prospective advertisers. I have a sample copy of this letter and brochure which has been put at each place. Follow-up letters will be sent out to these advertisers over the next several months.

The next move will be to contact, by letter, the machinery and mold suppliers to the industry, and the raw material suppliers. I have hesitated doing that, so far, primarily because it has been my experience that letters, unless addressed to individuals, do not get anyplace in the mail rooms of major companies. I know that in the past, we have attempted to get the names of individuals whom we might solicit and I know that we have had at least some small success. As I visit the various sections, I plan to buttonhole as many men as I can from the various prospective advertising companies and ask them individually who the man is in their company to whom advertising correspondence could be addressed. I have other thoughts on how I might obtain these names and I will greatly appreciate the suggestions of anyone here. I plan to meet with Clarke Cassidy for his suggestions and cooperation in this connection.

I feel that we must insure our continued break-even

(please turn to page 33)

Exclusive Easy-Acting All-Metal Valve

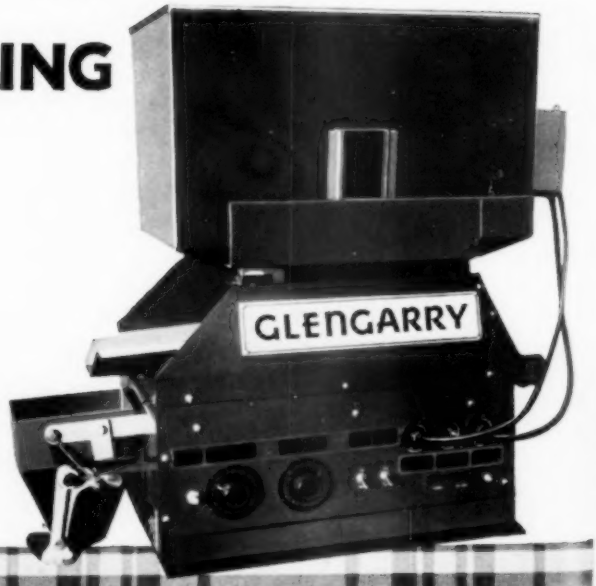
IMS SILICONE BOMB MOLD RELEASE

PURE UNDILUTED DRY-SPRAY
Forms A "Slick Quick"
Long-Lasting Non-Marking

Prices:
Sample Can $2.00
Unbroken Dozen $18.00
(at $1.50 each)
Unbroken Gross $197.40
(at $1.37 each)
Further discounts on larger orders

INJECTION MOLDERS SUPPLY CO.
3514 LEE ROAD WYoming 1-1424 CLEVELAND 20, OHIO

THE INJECTO-WEIGH
First IN WEIGH-FEEDING



To save money—Don't spend it!
To save material—Don't waste it!

Glengarry's Injecto-weigh saves money and material by cutting rejects to a minimum. An accurate charge of plastic *weigh-fed* to injection molding machines permits uniform weight and dimensional accuracy of molded products. For smoother production procedures and material savings, contact Glengarry at Bay Shore, New York. Ask about the Injecto-weigh.

GLENGARRY EQUIPMENT Corporation
BAY SHORE · NEW YORK

ESIGN and PRODUCTION NEWS

FOR CHEMICAL AND DESIGN ENGINEERS

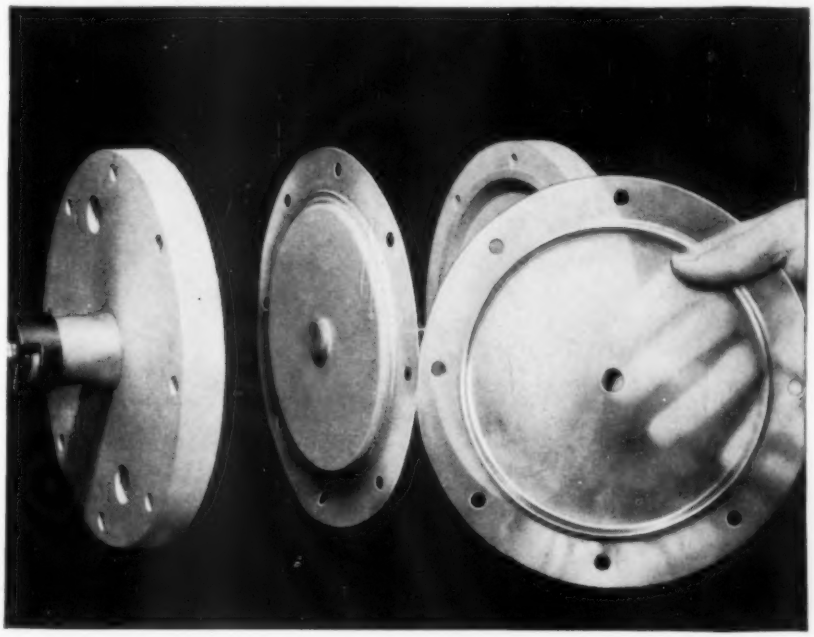
ished by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company

atter-Proof 'Copter be Glasses of Kel-F® sist Corrosion and ing...Prevent Leaks der Vibration

iding helicopter transmissions oil sight glasses seemed to be soluble problem until "Kel-F" tic was tried. No other mate- could survive the severe corro- extreme temperatures, shock vibration . . . and stay trans- nt indefinitely.

"Kel-F" was singled out for this ication because of its unique bination of properties. The mical inertness of this plastic at and high temperatures pre- ts damage by oils, sludges and s—from minus 65°F. to as high 300°F. The exceptionally high pressive strength and resiliency "Kel-F" in this temperature ge permit mounting bolts to be ed to leak tightness—without ttering or cracking the "glass". h impact strength protects the t glass against external damage. Nichols Engineering, Inc. of tford, Conn. fabricates these t glasses by molding sheets of el-F" polymer up to ¼" thick, g a special technique to obtain fect clarity. Standard machin- methods and tools are then ployed to true the edges, drill countersink bolt holes and ngrave the markings specified.

Refer to Report C-109



Paper-Thin Diaphragms of Kel-F® Control Wet Chlorine Gas...Maintain Accuracy of New Chlorinator...Permit Continuous, Dependable Operation

Viciously hungry chlorine gas is kept in check in a new "corrosion-engineered" chlorinator by three diaphragms of the type illustrated. Made of unique "Kel-F" trifluorochloroethylene plastic, these diaphragms extend the troublefree life and increase the accuracy of the precision instrument used in sanitation systems and industrial processes. The chemically-inert fluorocarbon plastic remains unaffected indefinitely in constant contact with highly-corrosive wet and dry chlorine gas under vacuum. The excellent flexural and tensile properties of "Kel-F" prevent the continuously flexing diaphragms from developing fatigue cracks and failing in service. Countless flexing cycles will not cause work hardening, precluding any loss in sensitivity with rapid breakdown. Replacing corrosion-resistant metal diaphragms, "Kel-F" is more flexible over the required temperature range, permitting automatic control of gas flow rates within a fraction of a percent of the required setting.

These diaphragms of "Kel-F" plastic, approximately 9" in diameter, are used in the "Ratochlor" chlorinator manufactured by Fischer & Porter Company of Hatboro, Pa.: in the instrument's differential pressure regulator, the vacuum regulator and the vacuum breaker. Made from type "A" Trithene* ("Kel-F" polymer) film supplied by The Visking Corporation, Terre Haute, Ind., each diaphragm consists of two sheets of 5 mil plastic. A circular bead is molded into each diaphragm face by the U. S. Gasket Company, Camden, N. J., for additional resiliency.

*The Visking Corporation's registered trade-mark

Refer to Report C-110

For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write

Technical Service
CHEMICAL
MANFACTURING DIVISION
THE
M. W. KELLOGG
COMPANY
P. O. Box 469, Jersey City 3, N. J.
or offices in New York, Chicago, Los Angeles

KELLOGG PULLMAN

Registered trademark for The M. W. Kellogg Company's trifluorochloroethylene polymers.

KEL-F
FLUORO CHLORO CARBON PLASTIC
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FLUORO CHLORO CARBON PLASTIC

Presenting the . . .

PITTSBURGH SECTION

First row: Henry C. Guhl, Westinghouse Electric, Section Director; Joseph P. Healey, Manco Corp., National Membership Committee; Erwin A. Rodgers, Pitt Mfg. and Distributing Co., Section President; P. J. Underwood, Executive-Secretary of SPE; James Q. A. McClure, Westinghouse Electric, Section Secretary; J. Giardinia, Vibro Roll Products, Section Director.

Back row: John E. Parks, The Hydraulic Press Mfg. Co., Section Treasurer; William F. Seiler, Pittsburgh Plastic Co., Section Director; and Joseph B. Schmitt, Koppers Co., National Councilman.

By James Q. McLure

BY ACTION OF the National Council on September 15, 1953, the Pittsburgh Section was accepted as a geographical section of the Society of Plastics Engineers, Inc.

The kick off meeting was held in the auditorium of the Mellon Institute, Pittsburgh, Pa., on the evening of September 24, 1953, with 40 persons in attendance. The meeting was opened by President E. A. Rogers who made some very pertinent remarks concerning the status and present rapid growth of the plastics industry in Pittsburgh and the surrounding area. Mr. Rogers particularly emphasized the need for a professional organization which would embrace the various phases of the plastics industry represented in the Pittsburgh area such as material suppliers, equipment and mold fabricators, molders, and the necessary attached sales organizations for end products. He then pointed out that the SPE embraces all these fields of activity and fills ideally the need of this section for such a common meeting ground for various technical people interested in the promotion and production of plastics. Mr. Rogers briefly introduced the temporary officers of the section who had been elected by the Steering Committee for a term to end at approximately the first of 1954. These officers were:

Mr. E. A. Rogers—President: Mr. Rogers is affiliated with the Pitt Manufacturing Company engaged in the molding of thermoplastic materials.

Mr. Eugene Dumas, Vice President: Mr. Dumas is affiliated with the Pittsburgh Plastics Corporation.

Mr. John Parks, Treasurer: Mr. Parks is Pittsburgh District sales representative for the Hydraulic Press Manufacturing Co. of Mount Gilead, Ohio.

Mr. James Q. McClure, Secretary: Mr. McClure is affiliated with Westinghouse Electric Corporation in the development and production of plastic parts.

Mr. Rogers next introduced Mr. Joseph Healey, President of the Buffalo Section of the SPE and Chairman of the National Membership Committee. Mr. Healey spoke briefly on the origin of the Pittsburgh Section describing briefly the very earnest activities of Mr. John Parks and Mr. Joseph Schmidt of the Koppers Company in making the initial necessary moves to contact the national organization for authority and to set up the Steering Committee which established the original basic organization for this section and made application for charter. Mr. Healey gave a brief history of the SPE pointing out that it is slightly over ten years old and was originally organized in Detroit, Michigan. All fields of plastics including plastic coating are covered by the Society. He made some general remarks on what is necessary for the success of a section and indicated that this success depends on the cooperation and earnest effort of all the members of the group in bringing to the attention of people in our industry, the existence of this group, and the benefits to be derived by association of persons with mutual interests in order that all might benefit from the knowledge and contacts of the other members of the group.

Mr. Rogers next introduced Mr. P. J. Underwood, the Executive Secretary of the SPE. Mr. Underwood discussed at some length the various benefits of membership in the Society such as:

1. Frequent opportunity to contact

(please turn to page 25)

Erwin Rodgers, Section President, officially opens the first meeting.

Joseph Healey, Chairman of the National Membership Committee, welcomes the Pittsburg Section into the SPE.

The Maker Tells How

Jesse H. Day
Ohio University

Plastics Know-How—A Guide To the Current Plastics Literature—Part III

A VERY IMPORTANT source of information about plastics materials, processes, molding techniques, applications and the like is contained in the magazines published by the companies who supply materials, machines or other services. These magazines are usually published monthly, bi-monthly or quarterly. While the range of topics covered by the whole list of magazines is very large, there is nevertheless a great deal of space devoted directly to the plastics industry in all of its many phases.

These company publications are among the best presented of all publications for attractiveness of make-up and accuracy of data. Invariably each magazine deals entirely with the products or services of the company which publishes the magazine. The total amount of material presented each month is roughly equal to that of the commercial magazines, so that this source of information should not be overlooked.

Some of the larger companies publish more than one regular magazine; and all of the companies also present a large variety of publications on specific topics or products which may be classed as catalog material, since these are not of regular issue in the same sense that a magazine is.

While is is well-known that a letter of inquiry to a manufacturer will bring information on his products, it may not be realized that there is a large number of regularly issued magazines which may usually be had free of charge by request on company letterhead.

The information in this article was obtained by writing letters of inquiry to over a thousand companies supplying materials, machines, dies and other services. It is hoped that the list of publications is complete, and if there have been any omissions, we would be glad to know of them. The list of publications is restricted to those which are issued on a regular schedule as magazines. The brief descriptive paragraph under each listing is intended to be indicative only of the contents, and each description is based on inspection of a single issue of the magazine.

The articles in these publications are usually general interest articles slanted toward the technical man in the business. Some of the articles tell about molding techniques, and some give data on materials. The articles are usually not of the same kind and extent as the articles in commercial plastics magazines. Where no information is presented as to interval of publication, that information was not given. Unless otherwise noted, the magazine is approximately 8½ x 11 inches in size.

AMBER-HI-LITES

Rohm and Haas Co., Philadelphia 5, Pennsylvania.

Bimonthly. January 1953 issue is No. 20, four pages, punched for 3-ring binder. Gives properties and uses of ion-exchange resins.

BAKELITE REVIEW

Bakelite Co., a Division of Union Carbide and Carbon Corp., 30 East 42nd St., New York 17, New York.

Quarterly. The April 1953 issue is Vol. 25, No. 1; has 28 pages. Contains general interest articles on applications of Bakelite materials.

CELANESE PLASTICS

Celanese Corp. of America, 180 Madison Ave., New York 16, New York.

The July 1953 issue is Vol. 11 No. 7; has 4 pages, with two inserts, and is punched for 3-ring binder.

News of uses of Celanese plastic products, and company news.

CELLULOSIC PLASTICS

Hercules Powder Co., Cellulose Products Dept., Wilmington 99, Delaware.

Issued three times each year. The August 1953 issue has 20 pages.

Contains 1 and 2 page photo and copy spreads of applications of cellulosic plastics.

CHEMMUNIQUE

Atlas Powder Co., Wilmington 99, Delaware.

Bimonthly; 4" x 9". The January-February issue is Vol. 1, No. 1; has 12 pages.

Short non-technical articles about applications of Atlas products, which includes some plastics materials.

DOW DIAMOND

Dow Chemical Co., Public Relations Dept., Midland, Michigan.

Bimonthly. The April 1952 issue is Vol. 15, No. 2; has 36 pages.

Articles slanted to the technical user of Dow products. Covers all Dow products, with a good portion devoted to plastics uses and forming techniques.

THE DUREZ MOLDER

Durez Plastics and Chemicals, Inc., North Tonawanda, New York.

The April 1953 issue is Vol. 25, No. 4; has 16 pages. 5½" x 7".

A magazine primarily for the compression molder on molding and application of thermosets.

DUREZ PLASTICS NEWS

Durez Plastics and Chemicals, Inc., North Tonawanda, New York.

The April 1953 issue is Vol. 20, No. 4; has 8 pages.

Notes on product improvements; data on molding phenolics. Aimed at designers and engineers.

EXECUTIVE NEWSLETTER

Monsanto Chemical Co., Springfield 2, Massachusetts.

Issued six or more times a year. About 8 pages; punched for 3-ring binder.

Semi-technical presentations of engineering aspects, such as design problems, and technical applications, with brief articles on such topics as shell molding, color and the like.

GOODCHEMCO NEWS

B. F. Goodrich Chemical Co., Rose Bldg., 2060 E. Ninth St., Cleveland 15, Ohio.

The May 1953 issue is Vol. 7, No. 5; has 4 pages.

Interesting applications of products and company news.

THE I P I ANAGRAM

Interchemical Corp., Printing Ink Div., 67 West 44th St., New York 36, New York.

The July 1953 issue is Vol. 1, No. 5; has 4 pages.

Devoted to printing inks; plastics materials are mentioned in the text as they apply directly in the printing ink business.

INTERCHEMICAL REVIEW

Interchemical Corp., 432 West 45th St., New York 36, New York.

The Spring 1953 issue is Vol. 12, No. 1; has 34 pages. 7" x 10".

Research news on inks; plastics incidental to main topic.

LESTER PRESS

Lester Engineering Co., 2713 Church Ave., Cleveland 13, Ohio.

Quarterly. 4 pages; 6" x 9".

Brief notes on molding and machinery; for the injection molder and the die caster.

PLASTICS MERCHANDISER

Monsanto Chemical Co., Springfield 2, Massachusetts.

Vol. 7, No. 1 came out in 1953.

A folder containing a number of brochures, each of which presents applications of plastics. Directed to the retail store buyer. This particular issue deals only with vinyl film.

PLASTICS MERCHANDISER OMNIBUS

Monsanto Chemical Co., Springfield 2, Massachusetts.

"Spring Edition" issue in 1953. 5⅜" x 7½". 60 pages.

For retail store buyers. A number of applications using Monsanto materials are presented together with name and address of manufacturer of each item.

PLASTICS NEWSFRONT

American Cyanamid Co., 30 Rockefeller Plaza, New York 20, New York.

Quarterly. The April 1953 issue is Vol. 8, No. 2; has 24 pages.

Application and methods; plastic materials, molding techniques, some testing methods.

PLASTICS PACKAGER

Monsanto Chemical Co., Springfield 2, Massachusetts.

Four pages.

Brief notes of successful packaging ideas, with a brief article about some aspect of the general problem.

PLASTICS PROGRESS

Chicago Molded Products Corp., 1023 N. Kolmar Ave., Chicago 51, Illinois.

Published about 8 times per year. No. 1, 1953 is 8 pages.

News and photos of products molded by Chicago Molded Products.

PROGRESS THRU RESEARCH

General Mills, Inc. 2010 Hennepin Ave., Minneapolis 13, Minnesota.

Quarterly. Summer 1953 is Vol. 7, No. 4; has 20 pages.

General interest technical articles on General Mills research and products. A fair share of these deal with plastic materials and chemistry.

R-B-H DISPERSIONS

R-B-H Division of Interchemical Corp., 432 West 45th St., New York 36, New York.

The June 1953 issue is 16 pages, celebrates 15 years of publication. 4" x 6¾".

This little publication contains anecdotes and general observations. Interesting. Included each month is a brief technical article.

RESIN REVIEW

Rohm and Haas Co., Philadelphia 5, Pennsylvania.

The March 1953 issue has 16 pages; punched for 3-ring binder.

Rohm and Haas plastic products; articles on applications, how-to-do, test methods and the like.

THE ROHM AND HAAS REPORTER

Rohm and Haas Co., Philadelphia 5, Pennsylvania.

Bimonthly. The July-August 1953 issue is Vol. 11, No. 4; has 34 pages.

Articles dealing with company products; a fair share of articles of technical nature on plastics.

THIS FORMICA WORLD

The Formica Co., Cincinnati 32, Ohio.

Quarterly. First quarter 1953 issue is Vol. 5, No. 1; has 16 pages.

Describes successful applications of Formica.

STRESS CRAZING OF PLASTICS

J. A. Sauer and C. C. Hsiao
The Pennsylvania State College

The effect of various factors on the inception and growth of crazing is reviewed and some of the similarities between crazing in plastics, exposure-cracking in rubber, and stress-cracking in metals are described.

Various examples of stress crazing in transparent plastics are presented and the stress-strain behavior reported for crazed, non-crazed, and oriented material.

Rate of propagation of crazing has also been investigated. The test results indicate that penetration of crazing cracks in polystyrene can be represented over a limited stress range by a linear function of both time and stress magnitude. Some measures advocated for avoiding the undesirable effects of crazing include use of special coatings, annealing, and establishment of working stresses based on onset of crazing rather than on static fracture.

This paper was presented at an annual meeting of A.S.M.E. and is printed with their permission.

THE ONSET OF CRAZING in transparent plastics is an undesirable feature that greatly limits their use in engineering applications. Various factors, such as temperature, time, orientation and environment have an influence on the initiation of crazing, but local stress intensity is probably more directly responsible for its occurrence and subsequent propagation than any other factor. The present investigation will therefore be concerned largely with this aspect although the effect of other variables will be briefly reviewed. Considerable information concerning the cause of crazing and its influence on subsequent behavior has been reported recently in the scientific literature (1,2,3,4)*.

Crazing in plastics has been defined as visible mechanical cracks (2) or as submicroscopic failures that result in a noticeable "blushing" of an otherwise transparent material (4). The term "crazing" has also been used to refer to a type of cracking produced randomly on

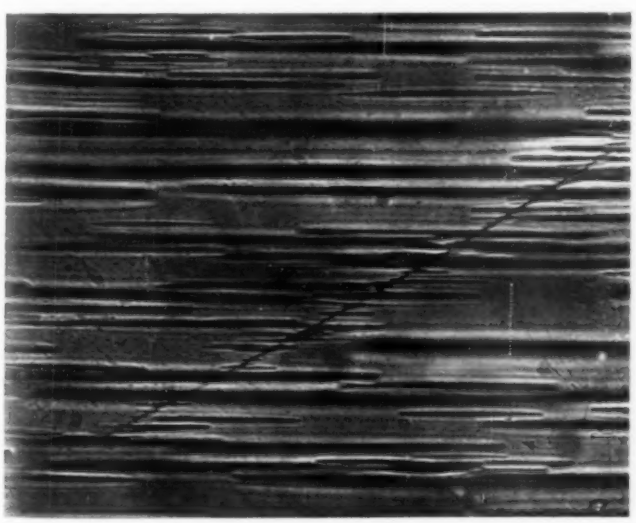

Fig. 1. Crazing cracks of Lucite viewed on the molded surface by transmitted light. Magnification 100 X; vertical stress. The diagonal mark is a scratch.

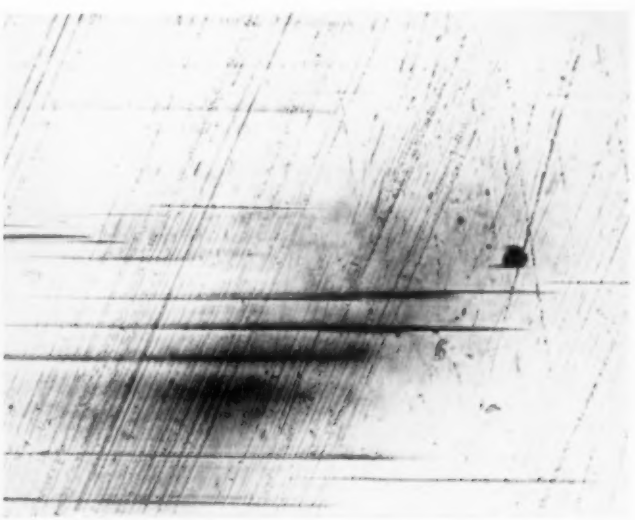

Fig. 2. Crazing Cracks of polystyrene viewed by transmitted light. Magnification 100 X; vertical stress. Slanted lines are polishing marks.

the surface of unstretched rubber by light in the presence of ozone (5). This phenomenon, however, has also been referred to by other terms, such as "sun-cracking," "atmospheric-cracking," "ozone-cracking," or "exposure-cracking." Newton (6), for example, has described as "exposure-cracking" the fissures formed in the surface of rubber at right angles to the direction of applied stress.

In the field of metallurgy, a closely related phenomenon to crazing is the cracking of metals or alloys when stressed under certain conditions. Stress-corrosion cracking of metals and alloys, and season-cracking of nonferrous metals, both of which have been intensively studied, are somewhat similar phenomena to crazing in that failure seems to be related to applied or induced stress. In metals, it is well known that cracks or fissures may be produced by rapid changes in temperature and these are believed due to development of induced thermal stresses. Cracks or local fissures can also be produced in rubber by exposure to ozone, but the phenomenon is greatly accentuated by the presence of an applied stress system.

In all instances where crazing cracks are caused by direct action of an applied stress system, the crazing cracks formed are at right angles to the maximum tensile stress direction. When stress is not directly applied, randomly directed crazing patterns can be produced and have been reported to occur in thermoplastic materials by solvent action, by X-radiation, and by ultraviolet radiation. In all these instances, stress does not seem to be directly involved. However, the possibility of the development of quite large localized internal stresses by any of these processes must not be overlooked. If such internal stresses are great enough to exceed the local failure strength of the material, crazing will result. Crazing patterns produced both by applied stress and indirectly by solvent action have been reported by Russell (2) and by Maxwell and Rahm (7).

The precise mechanism whereby solvents such as kerosene or benzene cause crazing cracks to originate and grow is not yet well-established. It is generally thought that the effect depends on absorption of the solvent by the material. Absorption softens the surface and may result either in some of the material reaching a critical elongation sooner or in causing a greater share of stress to be carried by surrounding material thus tending to produce local fissures, or openings. Another possibility is that as the absorbed solvent evaporates the surface material will tend to shrink and thereby produce internal tensile stresses sufficient to cause cracks to open up. Regardless of the precise mechanism, the crazing pattern would be expected to differ from that obtained by action of an applied tensile stress in that the cracks or crazing planes should no longer form a regular parallel system, but should be randomly directed. Such, indeed, is the case as has been shown by Russell for specimens of methyl methacrylate (8).

For a given applied stress magnitude, crazing appears to increase with duration of test (7, 9) and hence with creep elongation. Crazing also increases with increase of temperature. For polystyrene specimens, this effect has been shown by Maxwell and Rahm (7) for various temperatures from 30° to 70° C, for a stress level of 3600 psi and for various times from five minutes to half an hour.

Crazing in transparent plastics has also been reported (4) to be related to orientation. On a submicroscopic scale, it is believed that crazing cracks originate as separations of adjacent regions of polymer chains as a direct result of the applied local force exceeding the secondary attractive forces. It is therefore to be expected that in a highly oriented material subject to applied stress in the direction of orientation little or no crazing would occur since the applied forces would tend to draw the chains together rather than to separate them. This effect has been experimentally observed by Bailey (10) and by Cheatham and Dietz (11). If, however, in the same highly oriented material, the stress were applied at right angles to the direction of orientation, the chain separation should occur more easily and crazing should begin at even low stress levels.

DEPENDENCE OF CRAZING ON APPLIED STRESS

Observation of crazing in specimens subjected to applied loading reveals that the observed crazing cracks generally start on the surface and propagate in a direction perpendicular to the direction of maximum tensile stress. If a transparent plastic specimen is subject to uniaxial tension, crazing planes will develop and grow at right angles to the direction of stressing. These crazing planes appear simply as parallel lines when viewed from their side. Micrographs indicating this behavior for polymethyl methacrylate and polystyrene are shown in Figs. 1 and 2.

In Fig. 1, it will be noted that many crazing cracks originate along the diagonal scratch indicating the favorable effect of stress concentration on the initiation of crazing. Also numerous fine crazing cracks are found to commence along machine marks. This again indicates that crazing is more easily initiated when a local discontinuity in the surface introduces a high stress concentration factor and a resulting local stress considerably higher than the average stress in the specimen. This is what occurs at all outside edges of specimens where surface irregularities are unavoidable and hence we should expect that crazing will usually first occur on the external surfaces.

Fig. 2 shows a stress crazing pattern for a section of a polystyrene specimen. The original specimen was ½" x ½" in cross-section and subject to a constant tensile stress in its longitudinal direction. The micrograph shows a transverse view of a longitudinal section taken midway between the vertical surfaces. The inclined lines are polishing marks on the cut surface and the horizontal lines show the edge of the crazing planes. Some of these crazing planes have originated on the outside surface and have propagated to the interior of the specimen. However, new crazing planes not originating on the surface have evidently also been formed.

If a test specimen is subject to a tensile load which is maintained constant until fracture occurs, then its fracture surface will show crazed regions along the external edges, and non crazed or amorphous regions in the interior of the specimen. Fig. 3 shows such a partially crazed ½" x ½" polymethyl methacrylate specimen. The crazing cracks are clearly visible throughout the reduced gage length of the test specimen. The relative amounts of crazed and non-crazed regions depend on the duration of test before fractures occurred.

In Fig. 3 also are shown stress crazing patterns for several polystyrene specimens with different percentages of crazed and amorphous regions. Two distinct types of crack patterns are visible in Fig. 3; one type is the fracture crack system spreading radially outward from the more or less point source (presumably an internal impurity or flow) located in the center of the circle on the fracture surface; the second type is the much finer crazing crack system spreading normally inward from

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* *Numbers in parentheses refer to bibliography.*

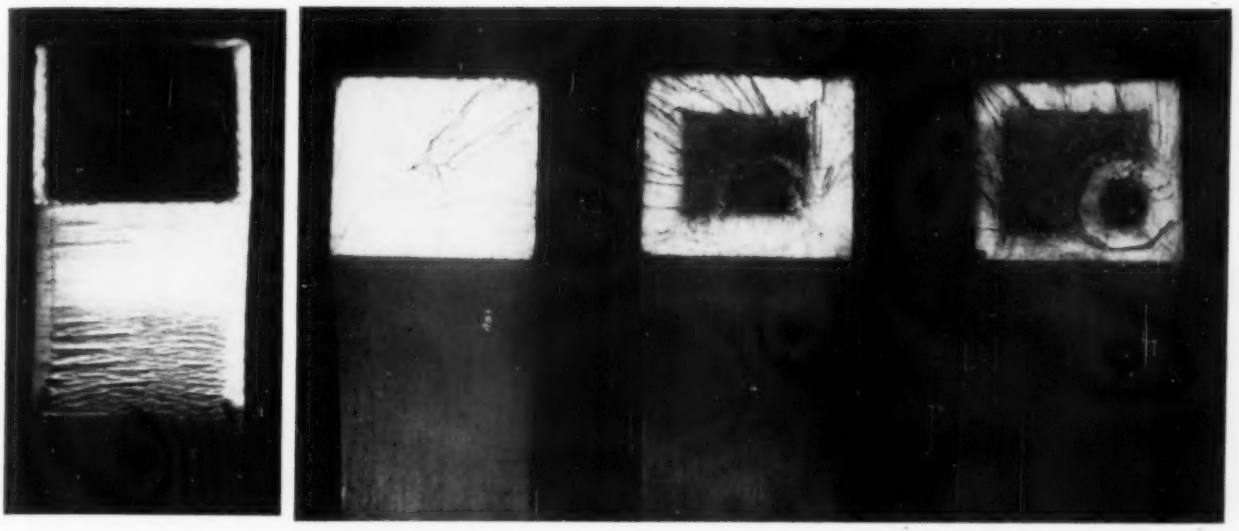

Fig. 3. (Left) Crazed tension creep specimen of polymethylmethacrylate. (Right) Fracture surfaces of crazed tension creep specimens of polystyrene subject to different stresses and different durations of load application.

the surfaces of the specimen. The depth to which these crazing planes extend and the rate of penetration of these planes depends upon the magnitude of the applied stress as well as on its duration, and appropriate quantitative relations for this variation are given later.

The qualitative dependence of crazing on stress magnitude and on duration of test is as follows: for comparable time periods of testing, crazing will increase with increase of applied tensile stress, and for comparable tensile stresses, crazing will increase with increase of time of testing period. Maxwell and Rahm (7) have noted that for thermal clean stress-free specimens of polystyrene no crazing at all as measured by reflected light intensity will occur until a tensile strain of 0.75% is reached, but that the amount of crazing would increase rapidly as the strain was increased beyond that value. The variation of crazing with time for specimens subject to constant load has been reported by Maxwell and Rahm (3) to be linear for times up to several hundred minutes. Sauer, Marin and Hsiao (9) have reported that for polystyrene specimens under high tensile stress loading, fracture occurred shortly after load was applied, with only slight or insignificant amounts of crazing around the edges of the specimen. For lower stress magnitudes, they reported that for some specimens fracture did not occur until hundreds of hours had elapsed and that crazing had by then extended over the entire cross-section.

It should be emphasized that crazing does not depend only on stress and time but also on the particular material under investigation. For example, for comparable stress and time as well as surface conditions, crazing cracks in polymethyl methacrylate specimens are usually larger and less dense than those in polystyrene specimens, but at the same time do not extend as far from the surface. These characteristics may be seen by comparison of the stress crazing patterns of Figs. 1 vs 2, and also of Fig. 3.

The effect of crazing on optical distortion can be demonstrated by the double reflection which the crazing cracks produce. This may be seen in Fig. 4 where the specimen on the left has been partly crazed as a result of being subjected to tensile stress for some time and the specimen on the right is unstressed. The double image is caused by the separate reflections arising from the crazed areas lying adjacent to the top and bottom surfaces.

A rather interesting observation reported by Sauer, Marin and Hsiao (9) is that polystyrene specimens may be completely crazed throughout their cross-section and yet continue to carry a considerable amount of load.

A specimen was machined from a larger polystyrene specimen ($\frac{1}{2}$" x $\frac{1}{2}$" in cross-section) which had been subject to a constant tensile stress of approximately 3000 psi for approximately 1000 hours. At the end of this time, crazing cracks extended throughout the cross-sectional area. From this larger specimen, a small round specimen was made and tested in tension. Its stress-strain curve together with that of the original material is shown in Fig. 5. The data indicate the fully crazed material has approximately the same ductility and somewhat more than one-half the tensile strength of the uncrazed material. There is also shown in Fig. 5 a stress-strain curve for a small specimen taken from the non-crazed portion of a larger tensile creep specimen. It will be noted that the strength is about the same, but the initial modulus is perhaps slightly greater than for the original material.

It is well known (4) that if a compressive rather than a tensile load is applied to a specimen of a transparent high polymer, no crazing will occur. In view of this, it was thought desirable to investigate whether applied compression would be beneficial in eliminating crazing previously produced by tension. A small test specimen was cut from a larger polystyrene specimen previously completely crazed in a tension creep test. The small test specimen was then compressed and released three different times and finally tested in tension to determine whether any beneficial effects could be noted. The pre-compression seemed to result in a partial healing of the crazing cracks.

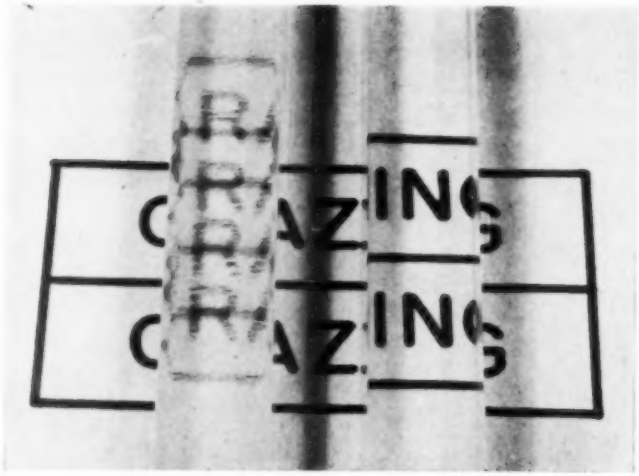

Fig. 4. Variation of index of refraction of crazed polymethylmethacrylate.

Probably because of the destructive influence of the distortion on the parallelism of the crazing planes and the apparent closeup of the openings between the crazing planes, the specimen at this time was quite clear to the naked eye with little visible signs of crazing. However, when viewed under a light microscope, crazing planes could still be seen. Hence, applied compression is at best only partly effective in healing crazing openings produced by tension. Also, if the pre-compressed samples are tested in tension, crazing cracks again open and no increase in strength is observed.

It was stated above that orientation has an effect on crazing. It also has an effect on the stress-strain characteristics and on the ultimate breaking strength.

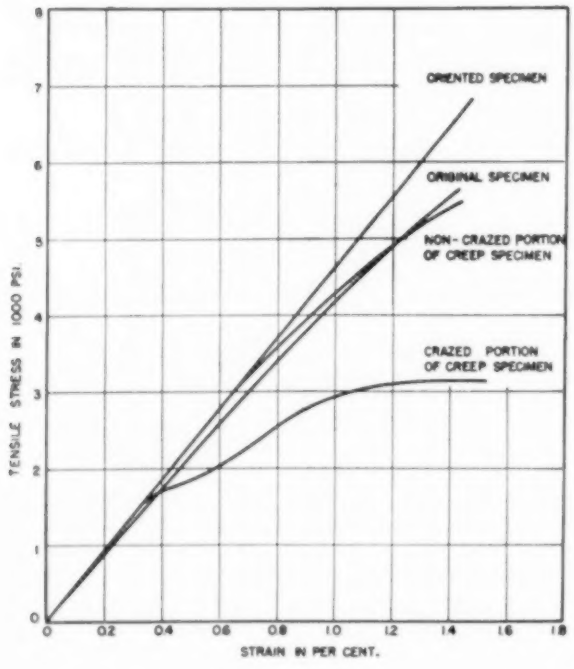

Fig. 5. Stress-strain curves of polystyrene in tension.

A statistical evaluation of the fracture strength for polymers subject to various amounts of orientation has been made by Hsiao and Sauer (4) and their predicted values check satisfactorily with the experimental data of Bailey (10) and of Cheatham and Dietz (11). One example of the effect of orientation on strength can be obtained from a comparison of the graphs in Fig. 5 marked "Oriented specimen" and "Original specimen." The "oriented specimen" was one that had been previously stretch-oriented approximately 300% in each of two biaxial directions. According to the statistical theory of Hsiao and Sauer (4), its strength should be approximately 25% higher than that of the unoriented sample. The graphs of Fig. 5 indicate that the experimental increase is approximately of this order of magnitude.

The particular "oriented specimen," whose stress-strain behavior is shown in Fig. 5, is one that was built up of a series of laminated layers of polystyrene—each layer having been biaxially stretch-oriented to the amount mentioned above. The test was conducted at a strain rate of about 190 x 10^{-6} in./in./sec. and the loading continued until fracture occurred. Despite the short duration of the test (one to two minutes) some crazing occurred and this was clearly visible on the fracture surfaces.

RATE OF PROPAGATION OF CRAZING

As mentioned above, under the action of a maintained tensile stress crazing cracks originate on the external surfaces of the specimen and propagate inward toward the center. To obtain information on the rate of propagation with time, it is necessary to have a continuous measure of the penetration of the crazing front. Since, however, the crazing cracks develop on all four external surfaces of the square specimens, and thus destroy visual transparency, it is not easy to measure the inward penetration of the crazing cracks until after the specimen has fractured.

Fortunately, this difficulty can be overcome by use of special coatings. As reported by previous investigators (4) crazing can be greatly retarded or even prevented from occurring by applying to the outside surfaces some synthetic polymer coating. (For polystyrene, one such coating is a solution consisting essentially of styrene monomer.) To obtain the desired visual advance of the crazing front, one coats two opposite faces of the specimens and leaves the other two faces free. On continued application of a constant tensile load, the crazing cracks will then start as usual on the free surfaces and grow inward as time passes. The coated sides, however, will remain essentially craze free and hence the depth of penetration of the crazing cracks can be easily observed and measured by viewing them from a direction perpendicular to the coated sides.

The cross-section of the specimens was approximately ½" x ½" and the gage length was two inches long. These specimens were cut from one-half inch thick polystyrene sheet. On the molded surfaces about one-half of the two inch gage length section was coated while on the other two sides the transparent coating extended to only about a quarter of the total length, the coating essentially prevented the initiation and growth of crazing from those surfaces on which it was placed, while other uncoated surfaces initiated crazing planes sufficiently intense to reflect light radiation. This method thus permitted the determination of the position of the crazing front from time to time and hence the rate of propagation of crazing could be found. The measurement

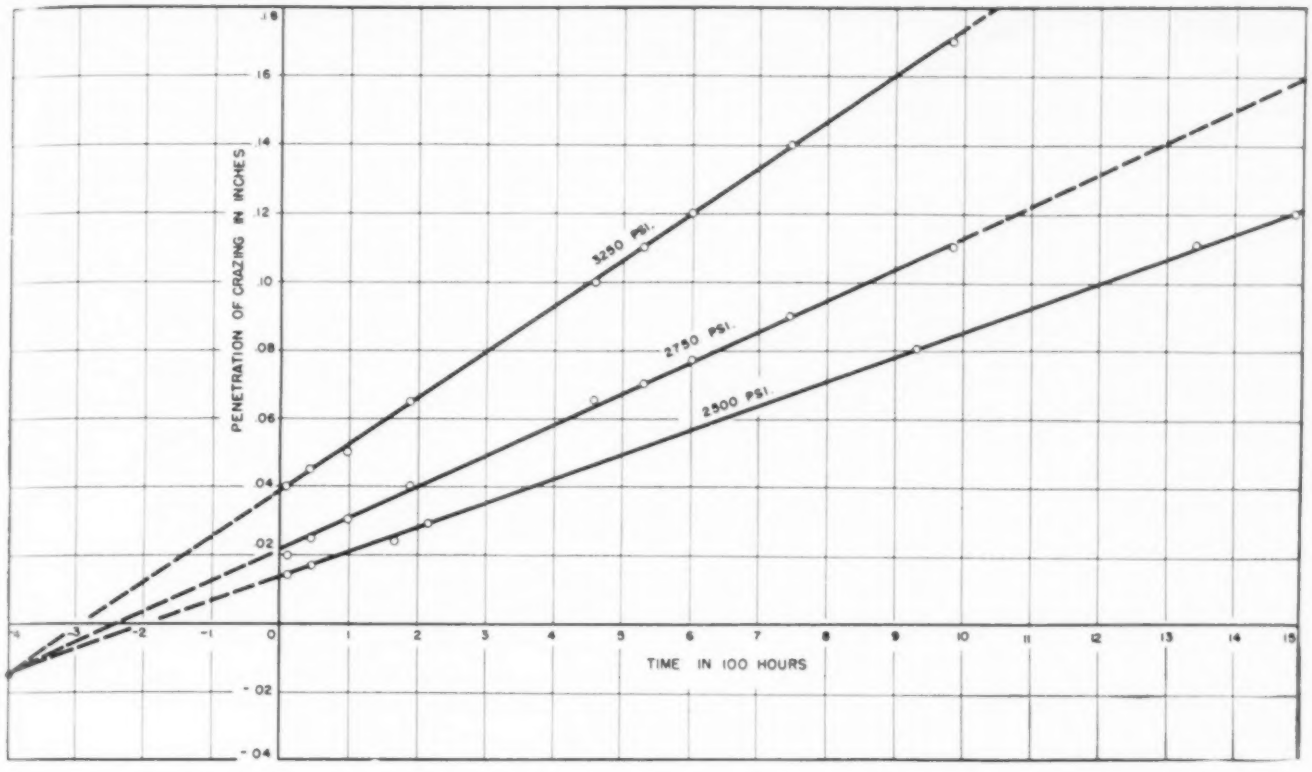

Fig. 6. Long time crazing curves of polystyrene.

of the position was made repeatedly by a micrometer at a given location and throughout the thousand hour duration of test. The test method, though not perhaps as precise as the light reflection method (2, 3) for determining the average amount of crazing developed throughout a given volume, is simpler and more appropriate for determining crazing penetration over long periods of time. A plot of the amount of penetration of crazing against time is given in Fig. 6 for specimens subject to three different stress levels as indicated. Due to the fact that polystyrene is rather brittle at ordinary room temperatures, many specimens, especially those at high applied stress levels, failed before any appreciable value of crazing could be recorded. The data indicate that the relation between penetration of crazing and time is a linear one over the stress range investigated.

It is interesting to note that these three long-time crazing curves at different stress levels show different amounts of penetration of crazing at the very start of the test. Usually, sharp cracking sounds could be heard soon after the load was applied which suggests the sudden appearance of crazing and the immediate release of a portion of energy into sound waves. If the first derivatives of these curves with respect to time are plotted against the magnitude of the corresponding stress level, it appears that the rate of displacement of the crazing front varies linearly with the stress as shown in Fig. 7 It is unfortunate that not more test points are available, but within the stress limits indicated the rate of crazing varies with the stress in the following manner

$$D = 1/m\ (\sigma - \sigma_0)$$

where σ is the stress in p.s.i.; m is the slope of this straight line; D is the rate of propagation of crazing front in inches per hour and σ_0 is a constant measured in stress units. Since the velocity of crazing is thus a linear function of stress, the depth of crazing can be written by integration as

$$D\text{-}D_0 = K\ (\sigma\text{-}\sigma_0)\ (t\text{-}t_0)$$

(please turn to page 32)

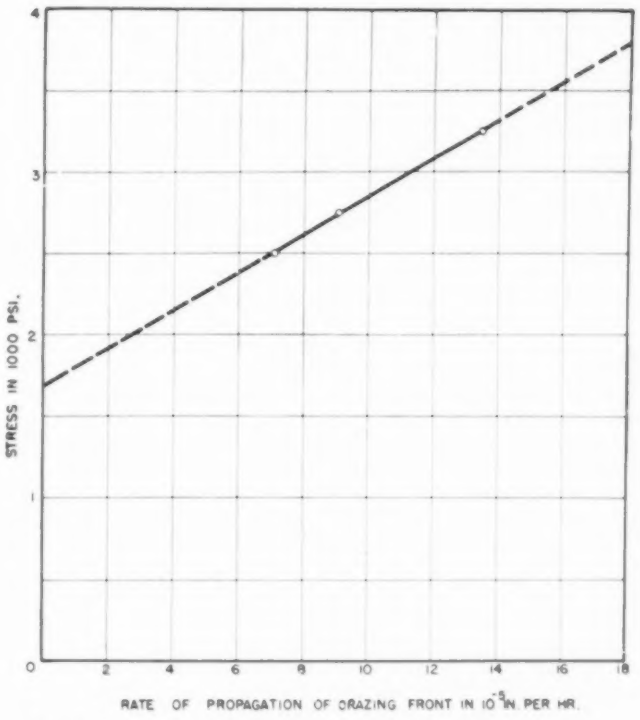

Fig. 7. Effect of tensile stress on rate of propagation of crazing of polystyrene.

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National Membership Committee SPE

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513 Security Bank Bldg., Athens, Ohio

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. . . . TO PROMOTE IN ALL LAWFUL WAYS THE ARTS, SCIENCES, STANDARDS AND ENGINEERING PRACTICES CONNECTED WITH THE USE OF PLASTICS:

By advancing the theory and practices of engineering and the allied arts;

By enhancing the status of the plastics engineering profession.

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III. A better opportunity to participate in the Annual National Technical Conference where a program of the newest and most important developments in the industry is presented by the most prominent men in the industry.

IV. For the recognition of plastics engineers within the industry and enhances the status of the plastics engineering profession in general.

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Fiscal year: July 1 through June 30.

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513 Security Bank Bldg., Athens, Ohio

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I certify that the statements made in the record of my training and experience are correct. I agree, if elected, to be governed by the Constitution, By-laws and Rules as long as my connection with the Society shall continue. I agree to promote the objects of the Society as far as shall be within my power.

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Date Signature in ink.

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Title or Position _____ Name of Company _____

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Nature of work done by company _____

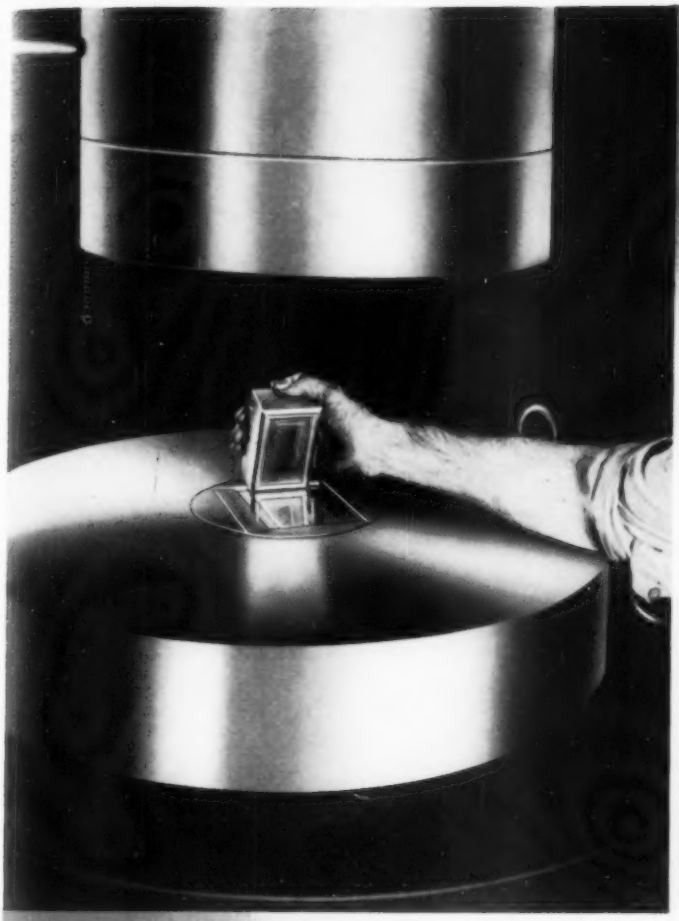
Explain in detail, the nature of your work and responsibilities _____

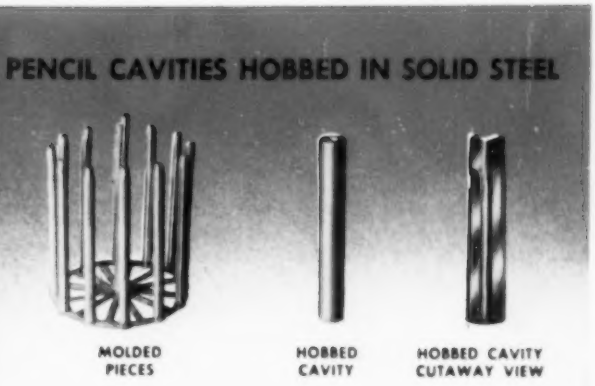
RECORD OF QUALIFYING EXPERIENCE

In the space below, supply complete record of past connections in detail. Describe duties fully and state briefly any important engineering work you have done. If space is not sufficient continue record on separate sheet of same size. **Your proper classification depends greatly upon the clarity of your record of experience and the degree of technical knowledge or skill required.**

DATES	NAME AND ADDRESS OF COMPANY	TITLE or POSITION	*RESPONSIBILITIES

COMPLETE BOTH SIDES OF THIS APPLICATION AND MAIL WITH INITIATION FEE TO S. P. E. OFFICE.





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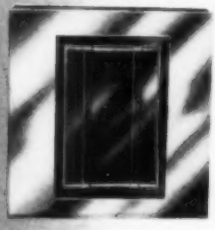

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A Symposium on

Part I

The Akron Rubber Group and the Cleveland-Akron Section of SPE jointly sponsored a symposium on Vinyl Compounding and Processing which was held on October 17, 1952 at the Mayflower Hotel in Akron. Over 700 interested members filled the ballroom to capacity to hear a panel of six experts from all phases of the vinyl-consuming industry answer questions on a wide range of topics.

Mr. J. C. Richards, B.F. Goodrich Chemical Company, served as moderator of the panel. Other members were B. K. Lyckberg, Firestone Plastics Company; Frank Steere, Steere Enterprises; K. K. Fligor, Goodyear; R. A. Mansfield, B. F. Goodrich; Don J. Siddall, U. S. Stoneware, and Frank A. Martin, The Hoover Company.

All of the discussion was recorded on tape, but since it ran to thirty-three pages it has since been edited and condensed by the panel members. This condensation retains the essentials of the discussion, since the answers to many of the questions were in a sense duplications. To conserve space further, recognition is not given to individual panel members for specific answers. The questions have been grouped according to subject matter into seven broad classifications.

MIXING

1. What are the "basic" technique methods in vinyl compounding preparing for extrusion as a continuous operation?

The basic techniques for a continuous extrusion operation are the following: (a) A blender for uniformly dispersing compounding ingredients. This will prepare a blend either for the dry blend process or for fusion before extrusion. (b) If a pre-fused feed is desirable, a process for fusing and feeding the extruder is needed. This can be done by mill fusing and strip feeding.

2. What advantages are derived from the order in which ingredients are charged to a Banbury type mixer when mixing powdered PVC compounds?

In producing colored vinyl products at what point in the mixing cycle should the color pigment be added, and what is the preferred form of color pigment?

Generally speaking, polyvinyl chloride batches are premixed at room temperature before adding to the Banbury. One method is to mix the polyvinyl chloride, plasticizers, stabilizers, lubricants, and filler in a ribbon mixer. This premixed mass is then charged to the Banbury and the coloring ingredients are added simultaneously so that they will be more or less in the center of the mass and then will disperse satisfactorily. Adding colors in this manner will keep the blender free of colors to facilitate cleaning, and also the color will not coat on the sides of the Banbury. In order to get good dispersion of colors, they should be used in predispersed form, such as pastes made up of color, plasticizer, and polyvinyl chloride. The only time when special order of addition to the Banbury is necessary is on unusual batches, such as those containing nitrile rubber.

3. What is the best method of mixing colored vinyl compounds?

There is no single one best method of mixing colored vinyl compounds. Color may be added in a Banbury or on a mixing mill as dry pigment, or dispersed in either plasticizer or in resin. If a ribbon type preblender is used to mix the ingredients before charging to the Banbury, pigments may be added at that stage. If the compound is to be used in the dry-blend form colors may be added directly to the blender either as dry powder or as color chips. Alternatively the color may be tumbled into the natural pre-blend either as dry color or in the form of chips.

4. Is the fluxing method of mixing going out in favor of the powder method?

The new types of resins have had an effect on the future of dry blends. There is room for both types, but in the long run there is an economic advantage for dry blends due to the elimination of the fluxing step.

5. What properties of PVC resin affect the ability of the resin to form a "dry" powder mix?

The plasticizer absorption property of the resin particles is the most important property in producing a dry powder mix, and is related to resin porosity, surface area, and particle size range.

Vinyl Compounding

MOLDING

1. What are the general molding temperatures and cycles observed on small vinyl parts?

Cylinder temperatures for injection molding elastomeric vinyl compounds fall in the range of 340 to 380° F. Generally speaking as the durometer hardness increases, the temperature increases. Sixty durometer compounds generally run at 350 to 365° F. The cylinder wall temperature is not a reliable guide to the actual material temperature which is usually 20 to 50 degrees lower than the cylinder temperature. The material is well plasticized and in an ideal state to mold at 320 to 340° F. Molding cycles are even more difficult to pin down. If you are only interested in making a part which duplicates the mold without regard to surface finish, then the time for the material to cool sufficiently to be ejected without deformation is the governing factor. In such cases, the cycles will be quite short. On the other hand, if you desire the best gloss, and freedom from flow lines, the cycle will be longer, since you can't do a good plasticizing job if you don't allow the material to stay in the cylinder long enough to be uniformly heated. In general, the cycles for PVC compounds run longer than those for polystyrene. Cycles run from 25 seconds to over two minutes.

2. Recommend gate and runner sizes for vinyl molding small parts. What causes dullness, flow lines and splay marks in molded parts?

Gate and runner size and dullness, flow lines, and splay marks in molded parts are closely allied. The so-called "pin-point" or restricted type of gating is generally recognized among vinyl molders as being the best type of gate. In conjunction with the pin-point gate the runners should be of the full round variety, and of generous size. The best practice is to start with a very small gate, and to slowly enlarge it as the new mold is being tested. Generally the gates will be of the full round variety approximately 1/32 inch in diameter for small parts. Length of the gate land should be about 1/8 to 3/16 inch. Runners will be from 1/8 to 3/8 inch in diameter. Arriving at the optimum gate size for any vinyl molding is largely a matter of trial and error. However, proper gating is an important, even vital part of successful injection molding of vinyl compounds. Dullness, flow lines and weld lines, and splay marks all stem from the same cause—improperly plasticized material. If the material is underheated, dull spots in the molding result. Underheated material will also cause flow lines and weak welds. On the other hand, splay marks (sometimes called splash marks) are the result of overheated material. It is not uncommon to find in a single fairly large molding evidence of both under and over heated material.

Vinyl compounds are much harder to plasticize in an injection machine than are other thermoplastics. The short-comings of the heating cylinders can be compensated for to a large extent by good gate and nozzle design. The use of a heated nozzle with a small nozzle opening, coupled with restricted gating will materially increase the plasticization started in the heating cylinder. Forcing the material through small nozzle and gate orifices generates frictional heat which completes the plasticizing action. Nozzle opening of 3/32" are in common use and most helpful. Spreaders with internal heaters, or with a copper body for better heat conduction from external sources appear to be one step to getting better plasticizing action in the machine. Another method is to de-rate the machine. Instead of trying to run a mold requiring 10 or 11 ounces of material on a 12 ounce machine, better results are usually obtained if the mold capacity is approximately one-half the rated machine capacity. The screw type pre-plasticizing type of molding machine also appears to be a good solution to better plasticizing action.

3. What factors in material formulation and molding technique affect the thermal stability of vinyl molding powders? Give a discussion of burning material in injection cylinders.

Two factors must be considered in the material itself as affecting thermal stability of vinyl molding powders. The first is the inherently poor thermal stability of the vinyl resins. Therefore, in formulating a molding composition an adequate dosage of the best available heat stabilizers should be included. The second factor is the relatively poor thermal conductivity of the vinyl compounds. In order to heat plasticize them it is necessary that they remain in contact with the hot walls of the heating cylinders longer than is required for the other thermoplastic materials such as cellulose acetate or polystyrene. Therefore, there is danger of the material in contact with the hot walls becoming overheated and of thermal degradation setting in before the material further away from the walls receives sufficient heat to be plasticized. The importance of the heating cylinder design should also be considered. It should be as well streamlined as possible to prevent any dead spots where material can lodge and decomposition start. It should have the heating elements and thermocouple controls so designed as to eliminate hot spots, and lastly, it should be so designed as to promote heat transfer from the torpedo or spreader into the vinyl material as well as from the outer cylinder walls.

As far as molding technique is concerned the most important thing to remember is to keep the material moving while the machine is hot. It is customary practice when shutting down a machine to first turn off the heaters and continue to mold as long as the material can be moved.

Vinyl compounds should not be permitted to lay in contact with hot cylinders, yet because of their poor thermal conductivity it is necessary to use comparatively long cycles which are conductive to decomposition. Once de-

composition starts the products of degradation catalyze the decomposition reaction. One of the products of decomposition is carbon. When a carbon layer forms on the cylinder walls it serves as a thermal barrier, so it is necessary to increase the heat input to the cylinder which in turn favors further decomposition.

4. Is injection molding of colored vinyl products practicable? What is the current situation with respect to molding of rigid unplasticized vinyl compounds—injection and transfer?

Injection molding of colored vinyl products is definitely practicable. All colors can be molded. Some judgment must, however, be used in the selection of the pigments. The molding of rigid unplasticized PVC compounds is still in the experimental stage. There is undoubtedly some demand for such moldings in the form of fittings for rigid vinyl pipe. However, to the best of my knowledge no one is injection molding unplasticized PVC on a commercial scale. Unplasticized vinyl chloride co-polymers can be injection molded, and are being molded commercially in a variety of applications. There is some experimental evidence that a screw pre-plasticizing type of injection machine can mold rigid PVC materials successfully, but I do not know of any such operation being carried out commercially. Transfer molding has been used quite successfully for rigid PVC vinyl pipe fittings, but is unsound economically. The long molding cycles required to heat and cool the mold make the process too costly for general use.

COMPOUNDING

1. What are the latest concepts in stabilization of vinyl resins?

The latest concepts in stabilizing vinyl resins against heat and light degradation have recently been discussed by Mr. H. Verity Smith in an article entitled, "The Stabilization of Vinyl Resins" appearing in the September 1952 British Plastics. A summary of this article indicates the dehydrochlorination of the vinyl resin results in the formation of conjugated polyene structures which are subject to oxidation. Therefore, the best stabilizers are those which act as acid acceptors, dienophilic and anti-oxidant. The organo-tin and organo-lead salts, as well as basic lead phosphate have been most successful in stabilizing vinyl compounds against heat and light degradation. Synergetic mixtures of stabilizers, whereby the one reinforces the other, increasing the activity of each, have been most successful in recent years. Each stabilizer manufacturer is most active in suggesting synergetic mixtures of stabilizers for specific applications.

2. What is the best stabilizer system for clear DOP plasticized compounds?

The best stabilizer system for a clear DOP plasticized compound is of the tin type. These compounds are somewhat costly, and would have an odor which may be objectionable during processing. Consequently, it may be justified to sacrifice slightly on clarity using a formulation of one part cadmium-barium laurate, one part of alkyl or aryl phosphites, and one part of an epoxy resin. This should provide a compound with a lower cost and with less odor.

3. What stabilizers for PVC compounds are considered non-toxic?

Calcium oleate, stearate, and ricinoleate and acetoacetates, together with disodium hydrogen phosphate and zinc stearate are approved by the Pure Food and Drug Administration. These stabilizers are not particularly effective insofar as is required for the processing of vinyl compounds.

4. Would a chemical which combined the properties of stabilizing and plasticizing be of interest to the trade?

With the business as specialized as it is, it would seem inconceivable that one combination of plasticizers and stabilizers would give the correct properties for all products. The vinyl business is no different from any in that as it grows, greater diversification results.

5. What is the best vinyl stabilizer?

I would hesitate to say that there is one best stabilizer, as stabilizers are expected to have special properties for special uses. Of course, the best stabilizer would be one that is transparent, is non-toxic, has good heat and light stabilizing qualities, has no odor, is readily dispersed, and will not discolor. Thus far, I haven't seen one of these.

One of the first stabilizers used was basic lead carbonate. It gives good heat stability but has the disadvantage of darkening when in contact with sulfides. It is still used to a great extent as a stabilizer. Other lead compounds are used and found to be effective. These are lead silicate, having a low refractive index, dibasic lead phosphate, and dibasic lead phthalate.

Another group of stabilizers are the organic tin compounds which give good heat and light stability and are transparent.

The barium and cadmium stabilizers are now attracting a great deal of attention, the barium primarily giving the heat stability and cadmium, the light stability. They have a high stabilizing effect, but, in some cases, tend to coat out on calender rolls.

Epoxy compounds are used to increase the light stability of vinyls. In stabilizing vinyls, the properties of the end product are considered along with the operations before a choice of stabilizers is made.

6. What is the best stabilizer to use with PVC against metallic copper?

Copper does not exert nearly as deleterious an effect on vinyl as does zinc, for example. The wire and cable people use a large amount of PVC in wire covering.

7. What is the future of permanent rubber-type plasticicers for PVC?

At the present time, nitrile rubber is used in certain instances as a permanent plasticizer. It is the least extractable of any of the present known plasticizers. In addition, it imparts good abrasion resistance to the compound. Its use is limited, however, because of poor low temperature properties, lack of really good non-staining age resistors which limit the usage to darker colors, and because of the fact that it is unsaturated, making a compound which is affected by oxidation.

8. Is there any basic information on the stabilizers of cheap petroleum plasticizers in vinyl dispersions?

So far as we know, there is no information that can

be considered basic on the stabilization of cheap petroleum plasticizers. Each particular compound has to be studied to find the best stabilization.

9. **What are the essential differences in compounding PVC for molding and extrusion applications?**

In the extrusion operation all of the forming operations are done at high temperatures. In the injection molding operation, the stock is heated up and then forced into a cold mold. This means that the molding compound must flow more readily than extrusion compounds.

In addition, the temperatures of injection molding are generally higher than those used for extruding.

This means that softer compounds or rather softer compounds at elevated temperatures must be used in injection molding than in extruding. This can be accomplished by using softer resins such as some of the copolymers and by the proper choice of plasticizers.

The injection molding compounds must be stabilized better than extruding compounds since the temperatures used are higher.

It is much more essential to have a well-mixed compound for injection molding than for extruding since there is no working action in molding and there is a certain amount in extruding.

10. **Does the optimum range of filler concentrations differ for extrusion and molding PVC compounds?**

The optimum filler concentrations for extrusion and molding products with the same physical properties are probably the same.

11. **What is the place of precipitated calcium carbonate in vinyl compounds?**

The precipitated carbonates are generally smaller in particle size than ground whiting. As such they are more difficult to disperse, and generally require treatment. It is possible to obtain a type of increased abrasion resistance. This type of abrasion concerns snagging, scuffing and cut resistance.

12. **Are there any pigments in production or of an experimental nature which have actual reinforcing properties in vinyl compounds?**

As far as is known, now, there are no inert ingredients which actually reinforce the physical properties of vinyls. Normally, they have a degrading effect. Some silicates do tend to increase the tensile and modulus but, at the same time, they may decrease the tear strength.

13. **Would it be possible to use magnesium silicates as a filler in vinyls?**

Magnesium silicates do not seem to improve tensile strength but they do have a refractive index close to vinyls. Use of them tends to have a degrading effect on the heat stability of the compound, which may be due to impurities.

14. **What is the present and possible future role of carbon black in vinyl compounding?**

Carbon black is still being used merely as a coloring ingredient. Thus far, we see no other advantage unless you consider very large amounts for improving heat transfer.

EXTRUSION

1. **What are the basic differences in extruders, dies, set-ups, and techniques used for extrusion of rigid and elastomeric vinyls?**

The basic differences in extruders, dies, and set-ups, as well as techniques in the extrusion of the elastomeric vinyls can generally be summed up by the following points:

A. A close and rapid temperature control throughout the entire equipment.

B. A very important point in the extrusion of rigids is the extent of the attention paid to the stream-lining of die-head parts and dies. This is a rule that should be followed in the extrusion of elastomeric but is many times neglected in favor of lower cost die design.

C. Problems of plating out fillers on the interior surfaces of metal which contacts the hot plastic can, in most cases, be overcome by selective compounding but in any event attention should be paid to the face of metal and its surface condition in order to avoid this property which, in the final analysis, ends in the destruction of stream-lining and promotes degradation of the stock. In this connection, it has been found that highly polished, low nickel stainless steels seem to afford the best conditions to remedy the situation.

D. Much has been said and written concerning the screw design for the elastomeric vinyls. It is rare indeed that a standard screw which satisfactorily handles the elastomeric will at the same time satisfactorily extrude a rigid compound.

E. After the compound has been extruded, the elastomeric can normally be handled on standard conveyor belt systems but in the case of rigid extrusions, whether they be pipe, rod, or profile, they require a different system of take-off involving mechanical movement and positioning during the cooling process.

2. **What is generally felt to be the best present design die for the extrusion of rigid vinyl pipe?**

Could we have a general discussion on the extrusion and handling of rigid vinyl pipe? With respect to die design the points to be considered are fully streamlined movement, highly polished and smooth surfaces, a uniform and full taper from delivery to outlet of die and positioning of the holding spider back of the outlet of the die as far as possible. In addition to these considerations, provisions for removable heaters over the die and their close control is very important. A few helpful suggestions on die design involve a very small constriction in the case of tubing dies and pins on the pin itself so as to provide sufficient back pressure on the material. It has been found that dies and pins constructed of Carpenter 158 have been satisfactory for avoidance of plating out since this is an easily machined stainless steel. It is also recommended that during the set up of the die-head and the die pin that they be wiped with Dow Silicone 200 so as to facilitate the movement of the first portion of material that comes through the die. The relationship of the taper of the die versus its length is one that has been discussed but as yet has no practical significance.

3. **How do you avoid porosity when extruding powder mixed PVC compound in thick sections?**

In extruding powder mixed PVC compound in thick sections, porosity can be reduced by having a dry free flowing and uniformly large particle pre-blend, extending the barrel of the extruder, having a high compression screw, and using screen pack to create back pressure.

Number and size screens used depend on the type screw and length of extruder.

4. Discuss dry mix vs. already mixed vinyl, and methods of preparation and extrusion properties.

A dry mix blend can be prepared using a jacketed ribbon blender, a jacketed double arm mixer, a heated Muller-type blender or a Hungerford blender equipped to add hot plasticizer and blow hot air through the blend. A ready-mixed compound can be prepared by Banburying or mill fusing and then chopping or dice cubing. A more uniform compound can be prepared by chopping extruded rods, and is probably more desirable for extrusion. A dice cuber can be used by strip feeding from a mill. Where facilities are available a strip feed is a practical way of feeding the extruder either continuously or semi-continuously. Except for porosity the quality and rate of extrusion of either type feed should be comparable.

5. When extruding a vinyl preblend with dispersed vinyl color concentrate granules, is it possible to obtain a uniformly colored product? If so, what special technique, equipment, pre-blend, or color concentrates are required?

We have limited experience with the problem of obtaining a uniformly colored product with color concentrate granules. For best results we would recommend a type of compound extruder such as the Baker-Perkins, Stokes Windsor, Farrell Birmingham, etc. The usual straight screw extruder will give difficulty in obtaining uniform color. Generally speaking, the smaller the particle size of color concentrates, the easier it is to disperse uniformly in the pre-blend.

6. What are the possibilities of extruding a rigid (unplasticized) PVC compound from a powder mix?—on a single screw and on a twin screw extruder?

Rigid PVC compounds are usually formulated with stabilizers, lubricants, and processing aids; and the concentrations of these ingredients are kept to a minimum so that important properties such as softening temperature, toughness, and strength are not sacrificed. Therefore, the powder mix method of compounding due to inability to adequately disperse the small concentrations of modifiers in the resin mass can be expected to give inferior properties to the product.

The twin screw extruder of tangential type should offer some advantage for powder compounding of rigids since the mixing zone designed in this type of equipment will effect greater homogenization of the compound.

7. Will the development of rigid vinyl compounds necessitate the need for a special design screw, or will the compounds be adapted to present standard screws?

Of course, every effort will be made to adapt the rigid vinyl compounds to standard extrusion screws. However, it is believed that conversion of rigid compounds to a satisfactory plasticity for extrusion requires the absorption of greater amounts of energy from the extrusion equipment than for extruding plasticized vinyl. For this reason better results will be obtained if specially designed screws are employed to give high pressures in the discharge end of the barrel.

8. What has been the overall success in industry of the twin screw combination mixing, fluxing, and extrusion type machines? What are the advantages of a twin screw type of extruder?

It is too early to say if twin screw extruders are successful, since most of these machines are on an experimental production basis. There are two types in use: (A) overlapping threads and (B) tangential threads. The tangetial types employ the same mechanical principles as single feed machines but a mixing zone permits a compound feed of a less homogeneous character.

The overlapping thread type permits a positive displacement and, therefore, can handle compounds which are difficult if not impossible to process in other extrusion equipment. This type offers some very interesting theoretical advantages, but it remains to be seen if the equipment will hold up mechanically.

9. What are the compounding and processing difficulties in the extrusion of vinyl film for food packaging?

The major consideration is the selection of non-toxic compounding ingredients. A number of plasticizers are available, but most of them tend to impart inferior heat stability to the compound. No effective stabilizers for vinyls have been considered non-toxic in light of the U. S. Pure Food and Drug laws.

Once a compound is selected which has the least risk as far as toxicity is concerned, the usual extrusion problems can be expected: holding color, maintaining clarity, thickness control, contamination and gell particles.

This article will be concluded in the next issue.

Book Reviews

CATIONIC POLYMERISATION AND RELATED COMPLEXES, edited by P. H. Plesch. Published by W. Heffer and Sons, Ltd., Cambridge, England. Price 20 -. 166 pages.

This little book contains the proceedings of a conference held at the University College of North Staffordshire in March of 1952.

There are 27 articles, dealing with complexes of metal salts with organic compounds, with cationic polymerization (mostly of styrene), and with other alkenes. This book is strictly for the practicing chemist, and performs an excellent service in rounding up much of the present day theory on the polymerization of unsaturates with metal ions.

Each of the articles is in the form liked by chemical journals, although there is considerable discussion appended. There are two appendices; one is a review of a symposium on carbonium ion reactions, and the other is on the overall activation energies of cationic polymerizations.

This is an important book for the polymer chemist.

PLASTICS FOR THE HOME CRAFTSMAN, by Rodney Hooper. Published by J. B. Lippincott Co., New York. 166 pages. Price three dollars.

The purpose of this book is well stated on the title page, "Characteristics of the chief plastics, working them by hand and light machines, improvising equipment, original designs to make, etc."

While the critical may find some faults, this is nonetheless an excellent book for the guidance of the hobbyist who wishes to make such things as boxes, lamps, trays and the like, or who wants to carve, emboss or engrave plastics, or cast. There are realistic and concrete directions on casting, drawing sheet plastics, and working plastics with hand tools and power tools.

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

"It is the freedom to disagree, to quarrel with authority, in intellectual matters to think otherwise, that has made this nation what it is today." Dr. James B. Conant

Lewis Acts!

TALK ABOUT ACTION! Last month I said in this column that the Lewis Injection Machine Hydraulic system could be simplified and improved. Instead of the unpleasant reaction I am used to, well blow me down if the Lewis people didn't call up and say they had read the article, and done something about it! In fact, they said that the piping had **already** been simplified, and that the new improved hydraulic manifold was even being installed "no charge" on new model machines just placed in the field! How's that for giving the poor downtrodden molder a real assist? It's good (a) to see our suggestion taken constructively as it was meant, and (b) to see that Lewis means business!

Plastic Wall Tile

As most injection molders of wall tile currently are realizing, the wall tile market is about shot to pieces due to price cutting, adjustments in new house starts and other factors. Not a few molders of tile are going out for custom work again as they have found the profit in the wall tile business to be very small. Basically, the problem in the plastic wall tile field is probably one of distribution, but I still think that there is a tremendous opening in the home market for a really good quality piece of thermoplastic wall tile. The trouble with injection molded plastics is that everybody thinks it is a substitute for something else and they cut the price and try to put out something that is cheaper in price and "feel" than the material normally used. What this country needs right now is a wall tile manufacturer with enough gumption to make a wall tile 3/16" or 1/4" thick and who will put this out in direct competition, price for price, with ceramic wall tile. I am sure that a properly molded piece of wall tile 3/16" thick, or a two piece tile filled with plaster of paris could be made which would sell in competition with ceramic tile and which would give the householder both performance and long life that you do not get in the thin, cut-rate tile that is currently being offered on the market. I wonder where there is a molder with enough courage and enough vision to see that injection molded plastics need not be a substitute any longer and can compete item for item with any material made in the correct application. It should also be pointed out that with a heavy section or weighted two piece wall tile like this, you can do a great deal with the back of the tile to improve its ability to adhere to the wall using undercuts, designs, etc., to which the cement can adhere. The back of the tile should definitely be a rough, unfinished surface as a great deal of trouble has been encountered because the back of tile made to date has been too smooth for the mastic to adhere to. At any rate, when a market like the tile market suddenly becomes shot to hell overnight as has happened to the plastic wall tile field, it is time for us to take a look at what causes an economic crisis like this and to see just what great opportunities it presents to a molder with real imagination and real vision who can act to take advantage of the situation.

Used Injection Machines

The recent marked improvement in new injection machine delivery schedules has caused a lot of injection molders to rue the fact that they did not sell their older machines (or the machines they were going to replace) last spring when the prices of used machines were at an all time high. Many injection molders who are now getting quick delivery of new machines on very favorable credit terms are getting quite a shock when they find that prices of used machines are going down. In fact, at the present time, there is little or no active demand for used presses of any type. From the numbers of ads of used machines being offered for sale in Modern Plastics and by machinery dealers who hear of used machines for sale, one would believe there was an active market in used presses. But several molders who followed up on some of the used injection press ads re-confirmed my own observation that most of the used injection machine lists are fictitious—merely come ons, and do not represent bonafide used injection presses immediately and unconditionally available. But whether the ads represent presses you can buy or not, they are a clear sign that an abrupt change has taken place in the injection machinery picture in the past 60 days.

The Pittsburgh Section

(continued from page 8)

other persons in one's field and related fields and discuss matters of mutual interest.

2. The prestige of membership in a national, widely recognized professional society in one's chosen field.
3. The opportunity to attend the monthly meetings at which nationally prominent speakers will discuss their particular specialties in the field of plastics engineering.
4. The monthly publication, the SPE Journal, which regularly contains technical articles by specialists in the various fields of plastics.
5. The opportunity to participate in the annual technical paper contest for which prizes of $200, 100 and 50 dollars are awarded for the best papers as adjudged by a special committee appointed for that purpose.

Mr. Underwood pointed out that the national SPE consists of 28 sections comprising approximately 2700 members and covers the United States, Canada and extends into Central America. In addition, there are members in England, Denmark, Germany, India and Sweden. Mr. Underwood announced that the Annual National Conference of the SPE would be held at Toronto, Canada in the Royal York Hotel on January 27, 28 and 29, and emphasized that all members who can possibly attend should do so.

The President, at the suggestion of Mr. Underwood and Mr. Healey appointed a Membership Committee Chairman to assume duties immediately. Mr. John Parks of Hydraulic Press Manufacturing Co. was appointed chairman of this committee. In his closing remarks Mr. Rogers indicated that the next meeting would be a general membership meeting at which a nationally prominent speaker would speak and that the November meeting would be a ladies' night affair at which the prospective members' wives would have an opportunity to become familiar with the activities of the Society. Details have been arranged for the October meeting which will be held the night of Thursday, October 29, 1953, at the Mellon Institute auditorium. Mr. W. A. Ward of American Cyanamid Company will speak on plastic molding materials and processes. A social period is planned before the meeting at the Webster Hall Hotel beginning at 6:00 PM followed by a dinner at the Hotel dining room at 7:00 P.M.

AROUND THE WORLD

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AUSTRALIA

AUSTRALIAN PLASTICS

Vol. 8, No. 94, May 1953

Abstracter: Albert Lightbody

PROCESSES IN GLASS-REINFORCED PLASTICS

This article, reprinted from "British Plastics," is accompanied by an editorial suggesting that the Commonwealth Government take immediate steps to free the industry from duties on glass fibre fabrics and mats and to grant unrestricted import licenses to importers.

RECOMMENDATIONS OF U.K. PRODUCTIVITY TEAM
Reprint from "British Plastics"

"Tetra Pak" plastic coated paper: Ingenious tetrahedral plastic coated paper package developed in Sweden for use in packaging of milk would save paper, labor, space and transport costs over conventional containers.

PLASTICS POSSIBILITIES IN ARCHITECTURE
By Dr. Walther Ehlers

The use of plastics as structural members, piping, glazing, floor covering, plumbing and insulation is covered.

PLASTICS IN FARMING

Aeration of soil by means of soil conditioners is discussed.

RELIEVING STRESSES IN POLYSTYRENE BY HEAT TREATMENT
By E. E. Halls

Reprint from British Plastics gives method of stress relief of polystyrene.

VINYL TYPE POLYMERS IN SURFACE COATINGS
By W. A. Edwards

Reprinted from "Plastics," London.

PLASTICS IN THE BUILDING INDUSTRY
By A. D. Robinson

The need for a considerable amount of research to obtain more data on aging is most important in the building trade.

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FRANCE

INDUSTRIE de PLASTIQUES MODERNES

Vol. 5, No. 7, July-August 1953

Abstracter: Hans Mayer

PLASTICS AND WINE GROWING

Covering a meeting of the "Technical Committee of the Wine Growing Industry" which covered the aspects of using plastic materials in the wine making and packaging industries.

INTERESTING FACTORS IN INJECTION MOLDING
E. Gaspar

This article describes pin point gating in injection molding.

COMPARATIVE STUDY OF MECHANICAL AND TEMPERATURE TESTS ON PHENOLIC TEST SPECIMENS
P. Dubois, P. Condette, M. Valayer

Different conditions which can influence the outcome of tests for flexural and shock strength are discussed.

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MATIERES PLASTIQUES ET RESINES SYNTHETIQUE

No. 65, July-August 1953

Abstracter: Alfred P. Daignault

REPORT ON THE SECOND EXPOSITION OF PLASTICS IN LONDON

A rather general report with emphasis on a description of compression and injection machines on display. Chief interest at the show seemed to be directed to the smaller presses and to the semi-automatic and fully automatic compression presses. Main interest at the show, however, appears to have been the display of certain large parts of polyester-fibrous glass material, namely a glider wing, a radar reflector, a water tank, and finally an automobile body.

CURRENT STATUS OF U. S. RESEARCH INTO SUBSTITUTES FOR BLOOD PLASMA

A short description of the three types of plasma substitutes presently available:

a) Sugar derivatives—Dextraun
b) Gelatins
c) Polyvinyl pyrollidone (PVP).

THE USE OF VINYL FILM AND SHEET AS PACKAGING MATERIALS
(Paper presented to The Swedish Plastic Federation in Stockholm by P. A. Sauter of Union Carbide Europa S. A., Geneva Switzerland.)

This article describes in some detail the use of vinyl in various packaging applications such as the use of film in 4 ply laminates with aluminum foil, polythene, and cloth for military packaging; as a coating for aluminum foil in packaging of foods such as butter and cheese; coatings for tubes, can linings and closures; and as a transparent package for products such as oleomargarine.

A NEW FOUNDRY PROCEDURE—CONTOUR MOLDING

A short description of the process as used by the International Harvester Co. in Chicago and the advantages including material and labor savings achieved.

PLASTIC APPLICATIONS IN THE CHEMICAL INDUSTRY

A photographic supplement showing a number of applications of polyethylene and rigid polyvinyl chloride in equipment for the chemical industry.

PLASTICS IN SURGERY

(A translation of a report presented at the 9th SPE Conference by Albert Lightbody of the Naval Ordnance Laboratory) and published in SPE Journal, Vol. 9, Number 3, March 1953.

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GERMANY

KUNSTSTOFFE

Vol. 43, No. 8, August 1953

Abstracter: Anne Schwend

DIAGRAMMING OF PLASTICS PROPERTIES

Dr. A. V. Blom

Since the sphere of applicability of macromolecular plastics is highly dependent upon the degree of temperature and the extent of the transition stage between solid and liquid materials, the author suggests for easier comparison of test results obtained by different scientists to sub-divide the information into different groups of common characteristics during a certain temperature range, during which the characteristics remain almost constant or show a jerky change. Characteristics serving as signal lamps for evaluation are f.i. the second order transition point, the specific heat, dielectric constant, modulus of elasticity, resilience elasticity, the power factor and others. Examples demonstrate practicality of suggestions.

BRITISH PLASTICS FAIR AND CONFERENCE 1953

K. Stoeckhert

A survey and brief on addresses held, new machinery and plastic items seen. Particular mention is made of the new preplasticizing method for an injection molding machine exhibited by Messrs. R. H. Windsor Ltd., calling for a built-in double screw extruder, the screws of which act both as pre-plasticizer and injection plunger, thus increasing the capacity from 280 to 900 grams; the Foster, Yates and Thom 50 ton fully automatic molding press, the mold cavities of which are refilled by blowing the powdery material through soft PVC tubes; the 70 ton pressure tabletting machine of B.I.P.; the high frequency welding machines of Radio Heaters and Redifon Ltd.

Among the newly developed materials particular attention was given the Akajou resins of British Resin Product Inc., the phenolic resins containing more than 80% of metal powder and the more heat resistant polystyrenes and cellulose acetates which latter claim greater dimensional stability properties than hitherto known.

The importance attached to post-forming techniques for thermoplastic boards, polyethylene powder for coating metals and the shock-curing of laminates with curable binders (developed by the Royal Aircraft Establishment) were noted.

SYNTHETIC RESIN FISH NET FLOATS UNDER EXAMINATION

Dr. A. V. Brandt

Fish net floats made of expanded polystyrene, PVC and rigid PVC are investigated for specific gravity, carrying capacity, buoyancy even under extreme conditions and resistance to temperatures from 8.6 to 212 degrees F. While results are very favorable compared with natural materials, the boiling of expanded PVC floats (when cleaning the fish nets) destroys them partly and lowers floatability considerably. Many plastic floats will not resist tar oils or carbolineum.

NEW GERMAN LITERATURE:

1. Farbenfabriken Bayer, Leverkusen

a. Leguval — Polyester resins for casting and low pressure molding.

b. Desmodur and Desmophen as Base Materials for Lacquers — Processing of di — and triisocyanates into new lacquer films of high resistance and valuable properties.

c. Pergut — History, properties and processing of chlorinated caoutchouc.

2. Badische Anilin — und Sodafabriken, Ludwigshafen

a. Vinidur — Corrosion-resistant PVC for lining and apparatuses.

b. Polystyrene III and VI — New leaflets on these standard types of polystyrene.

c. "Ultramid im Spritzguss" — Injection molding of polyamides.

d. BASF Products for the Electrical Industry — A survey on the utilization of various plastics for communications, high frequency and high voltage purposes.

3. Dr. Beck & Co. GmbH, Hamburg 28 — A detailed survey on properties, processing and utilization of a great number of lacquers for sundry purposes.

4. Chemische Werke Huels — "Vestyron" — properties of polystyrene types Standard and LS.

The preliminary program for the German Plastics Convention in Hamburg to be held October 7 to 9 is published.

FLOOR COVERINGS

Dr. Paul Kranzlein

A history and categorization of different floor coverings from the first attempts with wax cloth in the 18th century up to date.

NON-MARRING SYNTHETIC RESIN SURFACES

Dr. W. Burkart and L. Gerl

Tentative results of extensive tests to augment the mar resistance of all synthetic resin surfaces the surface film of which has either been damaged, removed or is non-existent, are published by members of the laboratories of the chemical factory of F. Menzer, Karlsruhe. Since the tests showed that loss of surface gloss is primarily due to marring while touching or carrying molded or plastic covered articles, the company covered specimen with a thin film of hard wax polish capable of emulsification and mixed with a plasticizer (a special sort of lavender oil). Items covered with such film can undergo the same finishing operation on the buffing machine as normally treated articles. The higher the revolutions of the buffing wheel, the higher the temperature melting the molecular structure of the surfaces, thus ascertaining a better incorporation of the plasticizer elements. Though the gloss obtained on plastic surfaces may not be greater than if treated with normal wax polishes, mar resistance increases considerably. Research is going on and cooperation by interested circles is urged by the company.

SIMPLE TORSION TEST FOR THE EXAMINATION OF PLASTICIZERS

H. Pisarzewski

The laboratories of the Pfalzische Gummi- und Plastik-Werke developed an apparatus for the photographic recording of torsional vibrations produced and shown by test specimen PVC/plasticizer compounds. Vibrations are registered in the form of lines of characteristic width and blackening intensity in which amplitude peaks are marked by a point-like broadening of the lines. Since this kind of registration requires little space it is possible to record a number of individual torsional tests on the same chart. Amplitude curves obtained allow observation of torsional vibration damping as well as changes thereof. A maximum in damping corresponds to a minimum in the amplitude curves and can easily be read off so that mathematical evaluation is superfluous. A description of the apparatus follows. Diagrams permit determination of the plasticizer effect as well as of properties inherent to the PVC/plasticizer compound in the second order transition point and the elastic range.

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DER PLASTVERARBEITER

Vol. 4, No. 6, June 1953

Abstracter: Ernest C. Bernhardt

APPLICATIONS OF PLASTICS IN ETCHING PLANTS—by H. Kalpers

Corrosion resistant plastic cements, coatings and sheaths are used around etching tanks. Description of materials.

WELDING OF POLYSTYRENE—by K. Brandenburger

Description of a heat sealing method used in packaging. Heat sealed polystyrene containers are illustrated, and automatic sealing apparatus is described. Closure is designed so that seal can be broken without damaging the container.

GREAT BRITAIN

BRITISH PLASTICS

Vol. 26, No. 289, June 1953

Abstracter: E. A. J. Mol

THE ELECTRICAL PROPERTIES OF POLYSTYRENE—J. J. Millane pp. 220-224.

Definitions are given and the basis discussed of such electrical properties of polystyrene as volume and surface resistivity, dielectric constant and power factor and dielectric strength. As polystyrene has outstandingly low losses even at high frequencies stress is laid on the application of polystyrene as a high frequency dielectric, complementary to polythene and polytetrafluoroethylene.

Heat distortion temperature, expansion coefficient, water absorption and surface finish and their influence on the dielectric quality of polystyrene are also considered. 15 references.

ONE PIECE MOLDED GLIDER WING—Anon. pp. 214-219

Mold construction and molding procedure for a 30 ft. glider wing shown at the second British Plastics Exhibition are the subjects of this amply illustrated article. The wing is low-pressure molded in phenolic impregnated asbestos material using a rubber bag technique and has a honeycomb core continuing right through top and bottom surfaces.

Vol. 26, No. 291, August 1953

THE LOW TEMPERATURE FLEXIBILITY OF UNPLASTICIZED POLYVINYLCHLORIDE

R. Hayes and D. A. Lannon. pgs. 310-315

The title of this article does not cover the subject as most of the work reported has been done on plasticized PVC. As a matter of fact, a number of commonly used plasticizers were evaluated as to their effectivity, that is, their ability to depress the so-called Cold Flex Tempeature (CFT).

In order of their effectivity, expressed as °C. /% plasticizer, those plasticizers were:

Dioctylsebacate (3.46), Dibutylphthalate (2.72), Dioctylphthalate (2.-63), Paraplex G 60 (2.53) and Tricresylphosphate (1.96). When compared on a basis of equal hardness at room temperature, DBP and DOP changed places. At concentrations under 35%, the CFT decreased linearly with plasticizer concentration for all plasticizers listed.

The CFT was determined following the well known method of Clash and Berg (Ind. Eng. Chem. 34 (1942) pp. 1218-22). This test consists essentially of measuring the angular deflection produced in a specimen of standard dimensions, when subjected to a constant torque at a series of temperatures.

Dimensions of specimen: 2.5 x 0.25 x 0,050 inches.

Torque: 5.68 dynes. cm. Time under torque: 5 seconds.

Coolant: Alcohol - carbondioxide mixture.

The angular deflection is determined at 5°C. intervals and the temperature where the angular deflection is 200° is arbitrarily called the Cold Flex Temperature. The Stiffness of the sample then closely approaches that of a PVC-compound containing 21% DOP or 28% TCP measured at 20° C. The CFT thus determined has a standard deviation of 1.32° C., 95% limits of 2.7° C. and thus is quite reproducable.

CONTINUOUS PRODUCTION OF RESIN-BONDED WOODBOARD

Anon. pp. 290-294

Describes a method and a machine for continuously producing endless lengths of woodboard which is cheap, uniform, 3/16-¾" thick. A paper facing can be applied in the same set up.

Chief features lie in the engineering of the six-steps compression section of the machine.

Both soft and hard woods are used as a raw material, the liquid bonding resin is sprayed in under violent agitation. The press is fully automatic and has a 90 KW. HF-generator to preheat the impregnated wood chips to 85-90° C.

THE PREPARATION OF STABLE MELAMINE-FORMALDEHYDE SYRUPS

E. P. Grimshaw. pgs. 306-308

The shelf life of melamine-formaldehyde syrups is limited, either by the formation of a white flocculent precipitation, terminating in a thick white paste, or by a steadily increasing viscosity, resulting in a clear translucent gel.

Both the precipitation (cause: crystallization of inadequately condensed melamine) and the gelation (cause: condensation proceeding too far) can be held in check by keeping the pH between 9.0 and 9.5, for which purpose, according to British Patent application 5531/53 (F. P. Grimshaw and the British Oxygen Co. Ltd.), addition of borax is the ultimate solution.

DEVELOPMENT OF IMPROVED-IMPACT POLYSTYRENE MATERIALS

Anon. pp. 286-289

A number of British firms do now manufacture rubber modified polystyrene types having higher impact strength, higher elongation at break but less out-door stability than unmodified polystyrenes.

They are:

Bakelite Ltd. (SX 17203, high impact)

British Resin Products (Distrene 500, high impact)

R. H. Cole and Co. Ltd. (R.H.C. Grade MHI)

Erinoid Ltd. (Erinoid HI, MHI)

Monsanto Chemicals Ltd. (Lustrex MI).

A table lists impact strength, elongation at break, modulus of elasticity, tensile strength, hardness, softening point, water absorption and specific gravity of all the types mentioned.

PLASTICS,

Vol. 18, No. 192, July 1953

Abstracter: Alfred T. Rexer

THE BRITISH PLASTICS EXHIBITION REVIEWED

A 17 page article covers the machinery and accessories, moldings and fabrications, material developments, and materials exhibitors which were seen at the June British Plastics Exhibition. The article is well illustrated.

THE BARTREV PRESS

A one page article describes the first of the Bartrev presses which is used for the continuous production of board material bonded with a synthetic resin.

METAL COATING FOR PLASTICS

A two page article with illustrations describes the coating of plastics moldings by the vacuum evaporation technique.

Vol. 18, No. 193, August 1953

18 YEARS OF EXTRUDED PHENOLICS

A two page article with illustrations reports the progress attained by a British plant which specializes in extruding phenolic tubing.

THE BRITISH PLASTICS EXHIBITION REVIEWED

A five page article with illustrations which concludes the article started in the July issue. Machinery is dealt with first, followed by moldings and fabrications, and concluded by materials.

EXPANDED AND FOAMED MATERIAL—by A. E. Lever, A.I.R.I.

A four page article reviews the various cellular products, in the grouping of sponge materials and expanded materials.

PARIS PLASTICS EXHIBITION

A three page article with illustrations covers the outstanding features of the Second International Chemical

(please turn to page 35)

A Survey of Connecticut Plastics Industry By David Mersey Presented to Connecticut Section

David Mersey

The first 53-54 meeting was held on September 11, at Bridgeport.

The group was honored with the presence of Jim Underwood who was fresh from a meeting with the Western New England Section, up north at Bradley Field.

Otherwise, the session was very local with the writer giving a talk . . . 'A Survey of Plastics in Connecticut.' It was shown that Connecticut, one of the smaller states in area, has been very active industrially from colonial days to the present. Starting with wooden nutmegs, then to a sizeable iron mining industry at the time of the American Revolution. After that the introduction of textiles along the banks of the three Connecticut rivers, not only into Connecticut but into Northern New England. Then came machine tools and aviation; and lastly, plastics.

Industrially speaking, Connecticut is sandwiched between two large areas, the two centering about New York and Boston. In terms of the plastics industry it is sandwiched between the New York-New Jersey and the Massachusetts areas which together comprise more than one half the nation's industry in this field.

In compiling this survey, as a working definition of plastics (excluding rubber) we considered that the medium is a synthetic, and is either resinous or cellulosic. Tool makers and fabricators were not tabulated. Nor was any count made of laboratories or specialists in pilot runs. However, within its bounds, this area has the oldest and newest equipment, and the smallest and largest capacities.

The tabulations follow:
Injection molders, forty four (44); Compression, comp. & transfer, (43); Extruders, excluding wire, (9); Extruders, wire (11); Film and sheeting mnfrs., (9); Coaters and impregnators, (5); Mnfrs. of inks, finishes, etc., (5); Resin mnfrs., thermoplastics and thermosets, for sale or own use, (10); Makers of finished compounds, thermoplastic or thermoset, for sale or own use, (21); Casting, thermoplastic or thermosets, (2); Expanded plastics, (1); Laminators, (1); Reinforced plastics, natural or synthetic fibers, (3); Forming, vacuum or pressure, (4); Dipping, enamelling, (5); Slush molding, plastisols, (3); Cold molding, (3); Mnfrs of major equipment, (4); Metalizing, vacuum, (2).

At the meeting the names of the various organizations listed above were read. This was a very accurate coverage of the plastics industry in this state.

Cleveland Hears McCann Predict A Bright Future for the Plastics Industry

Frank A. Martin

The Cleveland-Akron Section inaugurated the new Fall season by meeting September 14 at the Spanish Tavern. Guests for the evening were Mr. Hiram McCann, editor of Modern Plastics, and Mrs. McCann. Mr. McCann presented a very thought-provoking talk on the future of the plastics industry. Based on already announced expansion plans he predicted plastics production of 3 billion lbs. in 1953, 4 billion plus in 1955, and 6 billion by 1960. By 1955 we will consume 28.3 lbs. of plastics per person in the United States. Plastics have already reached the volume of copper, lead, tin, and zinc.

Mr. McCann predicted that there will be no trouble in using this greatly increased production of plastics. With the population increasing and with working hours decreasing there will be more leisure time to use plastic items. School rooms, home furnishing, and sporting goods are but a few of the virtually untapped potential markets for plastics items. Fields to watch particularly are the reinforced plastics and plastics pipe.

Mr. McCann further predicted that with the growth of plastics to "big business" will come necessarily a period of amalgamation and consolidation of small processors. The materials people will no longer be able to serve as bankers, development and research agencies, and merchandising advisors for the small fabricators. These functions will have to be assumed by the fabricators themselves, and in order to stay in business, the small companies will be forced to consolidate.

The speaker pointed out that at last designers are beginning to design with plastics, taking advantage of their properties, and not considering them as substitutes for wood and metal. As examples of outstanding designs, he exhibited the new Servel Wonderbar, the Eastman Kodak Verifox Printer, and the Admiral room moisture conditioner.

The interest and questions following the talk were ample evidence that Mr. McCann aroused interest and set his audience to thinking of the future of the industry.

Dr. E. L. Kropa Joins Battelle Institute

Dr. Edward L. Kropa has joined the staff of Battelle Institute in Columbus, Ohio, as chief chemical consultant, Dr. Clyde Williams, Institute president, announces. He comes to the research center from The Borden Company, New York City, where he was vice-president and chemical director of the company's chemical division. In his new position, Dr. Kropa will serve as an adviser to Battelle's varied chemical research groups which include the plastics and rubber division.

At The Borden Company, Dr. Kropa's principal interests were in various aspects of research and development in casein, wood and metal adhesives, foundry products, molding compounds, and industrial resins. He served concurrently as a consultant to the National Research Council's Advisory Committee on Quartermaster problems. He was employed as chemist to the head of the resins and plastics section of the American Cyanamid Company's Research Division in Stamford, Connecticut, prior to joining Borden.

Western New England Greets Jim Underwood

Ed Childs, Section President (Monsanto); George Rhine, (Cleworth Publishing); Jim Underwood, SPE's Executive-Secretary; and John Mallory, National Director for Western New England (Parker Stamp Co.)

West New England Visited by Ex.-Sec. Underwood Rhine Stresses Need to Know Other Industries

E. J. Sweeney

Western New England Section held the kickoff dinner meeting for the 1953-54 season on September 9th at Bradley Field Terminal, Windsor Locks, Connecticut. Mr. Jim Underwood, National Executive Secretary, and Mr. George W. Rhine, Editorial Director of PLASTICS WORLD and Vice President of Cleworth Publishing Company were the speakers for the evening.

The program was opened with a cocktail hour for members and guests. The Terminal provided guided tours of the control rooms and other facilities. The dinner was served in the new Terrace Dining Room.

Mr. Ed Childs, Section President, introduced the program chairman, Mr. Bill Bentley. Bill outlined the tentative subjects on the program for the coming year. New members and guests of the Section were introduced.

Ed then introduced Jim Underwood, giving a short resume of his background. Herb Hazenthal of Prophylactic presented Mr. Underwood with a single service of Prolon Dinnerware, promising to add the required services when needed. Mr. Underwood confined his remarks to the advantages to be gained from a strong national organization. He pointed out the necessity of the national helping the individual sections and the services he planned to develop and maintain. He limited his remarks because of the meeting program.

Ed Childs introduced Mr. George Rhine. Mr. Rhine has had a varied background in the Plastics industry, starting with the manufacture of veneer and moisture resistant plywood, using resin adhesives. During World War II, he worked on the development and manufacture of the T-44 frangible plastic bullet. Mr. Rhine has been with Cleworth Publishing since 1945. The subject of his talk was "What Is Ahead for the Plastic Engineer."

He emphasized the need of plastic engineers learning all they can about other processes of manufacture so that they will be able to develop the use of plastics. Shell molds for the foundry industry is one example; engineers working on this field had to become foundry experts. The knowledge of other industries is especially needed because of the growing tendency of companies to expand by going into other lines, rather than further expansion in their present line. Mr. Rhine also stressed the need of the Plastics Engineer to have an overall knowledge of the plastics industry, even though he is specializing in one branch.

The Terminal presented a movie after the talks. The subject had to do with the expanded use of planes in fields other than transportation.

New York Reviews Plans See Movie on Tenite

Arthur M. Merrill

The New York Section began the new season with a dinner meeting on September 16 at the Gotham Hotel, attended by some 75 members and guests. Following the custom of previous years, the session was the annual business meeting at which all members can express their opinions and ask questions about Section activities.

President Saul Blitz, Tico Plastics, Inc., presided over the meeting which began by having each person introduce himself. Mr. Blitz briefly reviewed the work of the Section, and introduced the other officers, directors, and committee chairmen. Reports were heard from the various committee chairmen, with each report followed by an open discussion. Much interest was displayed in the discussion of future meeting programs, and it was decided to initiate a series of plant trips as part of the program. Also of interest was the announcement that the Section now has 275 members.

Guest of honor was P.J.Underwood, the new SPE executive secretary, who was introduced by Stanley Bindman, Jamison Plastic Corp, and national vice-president. Mr. Underwood spoke briefly on the work of the Society, its aims and plans for the future, and the functions of the national office.

Another feature of the meeting was the first public announcement, made by William Lewi, Dusal Tool & Mold Co. and Section secretary-treasurer, of a new process for extruding phenolics which has been developed by Ionia Mfg. Co., Ionia, Mich. Samples of typical extrusions were displayed and aroused great interest.

The final event on the program was a showing of the Eastman Chemical Products Co. color-sound film, "The Story of Tenite," which illustrates the preparation, processing, properties, and applications of the material. Earl Dudney and Tom Loveless, both of Eastman, were present to answer questions.

Table favors were distributed through the courtesy of R. C. Molding, Inc., and the meeting concluded with a drawing for door prizes contributed by Brilhart Plastics Corp.; Hercules Powder Co., and Naugatuck Chemical Division, United States Rubber Co. The prizewinners were Fred Bellin, Leaf Plastics, Inc.; Lee Bodin and J. Foier, both of American Molding Powder & Chemical Co.; Henry Oettinger, Reilly Electrotype Co.; and Elmer Wodetzky, Suffolk Industries, Inc.

The next regular dinner meeting of the New York Section was held on October 21 at the Gotham Hotel.

W. P. ter Horst Starts Consultant Service

W. P. ter Horst formerly Head of Organic Research of United States Rubber Company, General Manager of the Fiber Division of Virginia Carolina Chemical Company and Associate Director of Research of Mathieson Chemical Corporation is now a chemical consultant with an office in McDonogh, Maryland near Baltimore.

Birney on Quality Control Interests Newark Section

Don Biklen

"Quality Control as applied to Plastic Molding" was the subject of an interesting talk given by E. W. Birney. Mr. Birney, Vice President of Consolidated Molded Products, addressed the Newark Section at the first fall meeting September 9th.

Mr. Birney pointed out that great accomplishments have not been made in statistical control but at the same time, only small amounts of money have been spent. With large charts, the speaker explained the frequency curve. By checking a given number of molded pieces by 100% inspection, a frequency curve can be made and after having this curve, the molder knows exactly where he stands regarding tolerances. If this curve falls within the tolerances with a little leeway to spare, the need for close inspection is unnecessary. However, should the curve touch or go beyond the permissable tolerance, corrective action should be taken immediately.

In custom molding such as Consolidated Molded Products has been doing for the past fifty years, it is quite usual to run a mold, put it on the shelf for perhaps 6 or 8 months, and then put it back in the press again. If a particular mold has had parts with defects or a dimension to be cautious of, a record should always be made and kept so that the molder will know what to look for when making a run from an old mold. Beneficial information like this should not be left to the foreman or operator to remember — it should be recorded.

Mr. Birney gave 3 case histories of quality control on molded parts. One was phenolic, one was urea and the third, nylon. These parts were distributed to the audience in order that the effectiveness of quality control could be appreciated. A chart for each part was described by the speaker and how, under careful statistical analysis, each job could be carried to its successful completion.

Mr. Robert Butzko, of Auto-Vac Co., Fairfield, Conn. was the second speaker. His talk on "Horizons in Vacuum Forming" opened the eyes of the Newark audience. Low initial investment in tools for vacuum forming is perhaps the biggest single advantage. Time for tooling up is short and if a product proves to be a flop on the market, a large investment is not lost.

Fields that offer great potentials in vacuum forming — upholstery, luggage, packaging, novelty, appliance, and advertising. A transparent spark plug package with individual compartments shaped exactly like the plug was shown to the group. False faces, predecorated, then vacuum formed offer an interesting future. Santa Claus faces and figures are done in the same manner.

Molds used in vacuum forming are made from aluminum, electroplated or sprayed metal, or even plaster. Some molds are channelled for water cooling when heavy plastic parts are formed.

The display and decorative fields are using vacuum formed parts to great advantage. Mr. Butzko had a fair sized vacuum formed display approximately 40 in. x 26 in. which was quite striking. Many other parts were on display.

Injection molding versus vacuum forming — the speaker described the limitations of forming — holes and undercuts cannot be formed. However, the costs of machinery and molds are considerably less. An example was cited where an injection mold cost $18,000 with a unit part cost of $14.95. The same part was vacuum formed and sold at $4.95 with a mold cost of $500! Television frames are good applications for vacuum forming — one week was required to tool up and make a sample frame.

At present, the maximum size machine is 60 in. x 90 in.; maximum weight of sheet — 35-40 lbs. and maximum output 350-400 lbs. / hour. A machine to operate at this rate costs approximately $10,000.

Materials used are acetate, acetate butyrate, styrene, modified copolymers, rigid vinyl, and the acrylics.

Following the speakers, a question period was held.

Eastman Chemical Products Corp, has transferred Jack Pecktal, President of the Newark Section to Cleveland. In a special directors meeting Joe Bonanno of the Lionel Corporation was unanimously elected to fill the unexpired term.

Art Warner of Federal Telecommunication Laboratories has been transferred to London England.

November 18, 1953, Newark will be guests of the New York Section.

NCR Entertains Miami Valley

John L. Russell

Miami Valley Section SPE members and their guests enjoyed a late summer picnic at the National Cash Register Co.'s Old River Park in Dayton on Thursday, September 10. This was the 7th Annual Picnic for the SPE group at Old River and it opened the 1953-54 season of activities for the Engineers. As in the case of former years Chester Kruger again served as chairman and arranged another fine program. For sports and games badminton, horseshoes and miniature golf were indulged in. A miniature golf tournament was staged and two men tied for low score, Jack Baxter and Merle Nelson. Dave Lucid was the high score man. All three were presented prizes for their accomplishments.

A roast beef dinner was served. Our National President, and also Miami Valley Section member, was presented with a cake in honor of his position as National President of the Society of Plastic Engineers.

Mr. Joseph Price, NCR Metallurgist, gave a very interesting and informative lecture on "Powder Metal Processes."

National President Walter Oelman reminded the members to make their own personal reservations for the Toronto Technical Conference.

President Joe Merke announced the next meeting to be on Thursday, October 1, with a dinner meeting at the Eaton Manor in Hamilton, Ohio. Prior to the scheduled talk of the evening a 30 minute forum on "Current Topics" with prepared questions will be participated in by the members. A slide illustrated talk on Mold Design and building will follow.

Central Ohio Visits Denison Engineering

R. W. King

The September meeting of the Central Ohio Section was held on September 15, and consisted of a dinner meeting at the Knotty Pine Restaurant, followed by a tour through the plant of the Denison Engineering Co., 1160 Dublin Road, Columbus, Ohio. Although Denison is best known for their HydrOILic MULTIPRESS, they also produce an extensive line of hydraulic pumps and controls, and other hydraulic equipment — distribution now covers the entire world.

Prior to the tour, the group was shown a movie which described the operation of the Multipress. Although this press is now used directly in the molding of plastics, it can perform many finishing operations with speed and efficiency. All presses are furnished with safety devices for the protection of operators. Of interest in the plant tour was the well-equipped job testing laboratory. The services of this laboratory are free to potential users for pre-testing jobs on the Multipress.

The members of the Central Ohio Section would like to take this opportunity to publicly thank the management of Denison Engineering Co. for the courtesies extended to them during this tour.

Stress-Crazing of Plastics

(continued from page 17)

where D_c and t_c are constants and K = 1/m. For polystyrene D_c = -0.015 in., K = 0.851 x 10^{-7} in. hr. psi, σ = 1670 psi, and t_c = -400 hours.

Thus, within the limited range of stresses as indicated in Fig. 7, the depth of crazing may be expressed as a linear function of both stress magnitude and time.

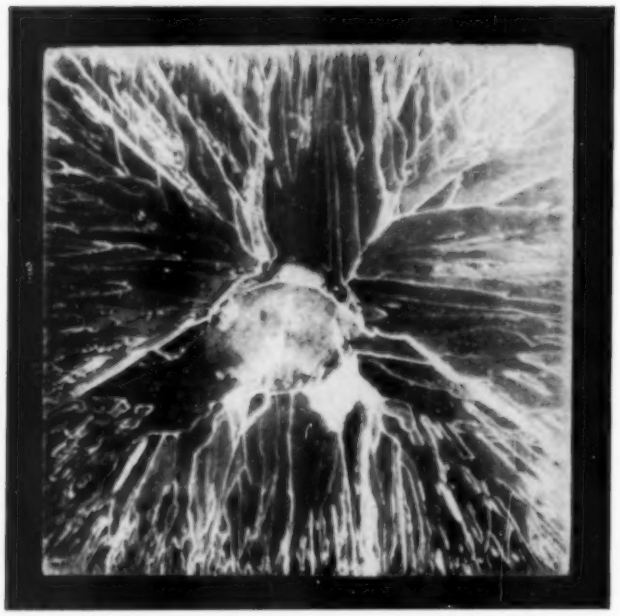

Fig. 8. Fracture surface of crazed tension creep specimen of polystyrene.

It is questionable whether the above equations can be extended to much lower stresses but their implication that the rate of propagation of crazing goes to zero for some limiting stress value does seem to be in general agreement with experimental results (9). It is also difficult to investigate the above relation for much higher stresses than 3500 psi as the specimen tends to fracture in much shorter time periods and thus not much data on crazing can be taken. Such short-time fractures are frequently caused by obvious flaws such as that shown in Fig. 8, which result in high local stress intensities. The actual fracture cracks, as distinct from the crazing cracks, very frequently start from some point inside the specimen and then extend rapidly radially outward as Fig. 8 indicates.

DESIGN IMPLICATIONS OF CRAZING

The development of crazing in stressed transparent plastics is for the most part a highly undesirable occurrence, although beneficial use is made of this phenomenon in the use of transparent brittle lacquers to predict the direction and approximate magnitude of surfaces stresses on machine and structural parts. In other applications, however, such as transparent enclosures on aircraft, transparent instrument panels, and as insulators in electronic apparatus, the initiation of crazing is cause for alarm either because of loss of transparency, loss of mechanical strength, or loss of dielectric properties due to moisture absorption in the crazing openings. Also since crazing once started will continue to increase without increase of load magnitude, it is well to avoid its consequences by taking every precaution to avoid its inception. As already noted, surface coatings are helpful and can be recommended. Also, working stress magnitudes should be established not merely on the basis of static ultimate strength, but on strength values at which crazing is found to occur. In applications where the plastic part may be subject to tensile stress in varying directions, full annealing of the transparent plastic sheets is highly desirable, as, in this way, the material can be made more nearly isotropic. On the other hand, if the plastic part is to be used only under uniaxial tension, then higher working stresses can be obtained, without danger of crazing, by use of highly oriented material. Essentially, the reason is that in the oriented state all the molecular chains tend to align in the direction of orientation and crazing which is thought to be a result of lateral separation of adjacent chains (4) can then not occur. Crazing will, of course, occur in oriented materials and at low stress values if transverse tensile rather than axial tensile stress is applied. If, therefore, the intended application is such that there is a probability of lateral as well as longitudinal tensile stresses occurring, then the isotropic annealed state is preferable to the highly oriented state.

The authors wish to thank Professor D. A. Kribs of The Pennsylvania State College for his help in making most of the crazing micrographs, and also express their appreciation to the Office of Naval Research for financial support.

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Catalog of Polymers

Monomer-Polymer, Inc. has recently issued a new catalog of over 300 specialty research monomers and polymers. The physical characteristics of these chemicals are given. In addition to the general listing, there are separate sections of catalysts and accelerators, monomers for polyelectrolytes, substituted ethylenimines, and cross-linking agents.

Your National Office

(continued from page 6)

advertising through these means, but as far as the future of the JOURNAL is concerned the place to start is by increasing its circulation.

INCREASING JOURNAL'S CIRCULATION

Now, obviously, this can be done in two, or at the most three definite ways. I have already started one way and that is to solicit directly the college libraries for subscriptions. The publications committee started this project and it was brought to its culmination just last week when a bulletin (copy of which is in front of you), and an issue of the September JOURNAL together with a new subscription blank, which we just had printed up, were sent to approximately 1000 libraries. The next move will be to solicit the large city public libraries.

Mr. A. R. Morse has made an excellent suggestion for a second way to increase the circulation of the JOURNAL. He has suggested that we send complimentary copies out circularizing the entire plastics industry for company subscriptions which I recommend for your approval.

Now the third way to increase the circulation of the JOURNAL, and the most rewarding one, in many ways, is through an increase in membership.

MEMBERSHIP CAMPAIGN OF 5000

Joe Healey is doing a marvelous job as National Membership Committee chairman. He has come up with, and developed, many new ideas for promoting membership. With his continued enthusiastic support combined with the assistance of the National Office, I feel that a membership campaign can, and should be, undertaken immediately. It is my belief that doubling the membership during the coming 12 months should be set as a goal. The revenue to be derived from a membership of 5000, will give the society a budget on which it can relocate without any qualms. The JOURNAL, with a circulation in excess of 5000, will become very attractive to prospective advertisers. (I understand that this is one of the breaking points that advertising account executives take into consideration in distributing their clients' dollars.) That will be the time to decide, in my opinion, whether a major advertising campaign is to be undertaken. And that will be the time to consider the possibility of turning the JOURNAL over to a publisher's representative. The details of the membership campaign, I feel, should be worked out in conference with Joe Healey, others he might select on the Council, and myself.

I have, so far, attended the meetings of two local sections; namely, Western New England, and Connecticut. I feel that just my presence alone at these meetings adds spark to a membership campaign or any other campaign the society might wage. When I say my presence, I mean as the traveling representative of the National Organization.

In the September issue, and in the coming issues of the JOURNAL a new column will appear called, "Your National Office." Through this medium I hope to stay in monthly and direct contact with the entire membership. This column might also be used by national committee chairmen to get their messages directly to the members. It is through these means that I feel we can do much to help all national committee chairmen.

REACH THE STUDENTS

Also on the subject of increasing membership, one vital area, and I feel an essential one, is the colleges and universities. Certainly, it is most important that we get our message to the students in the colleges and universities today, who are our prospective members for tomorrow. Perhaps the Educational Committee can join the Membership Committee, and the National Office in this enterprise.

A PROGRAM

My report to you at this meeting has been primarily a recommended program which is the result of an attempt to analyze carefully the problems now facing the society. It is presented to you in broad outlines. It represents several policy decisions to be made by you.

I offer this program for your consideration, for your approval or disapproval. If you adopt it, I will then have the authority to put this program into operation, which is my purpose in presenting it to you today.

Thank you.

[The National Council unanimously accepted this report as presented and directed its publication in the JOURNAL.]

P. L. Underwood

Executive Secretary

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TECHNICAL CONFERENCE
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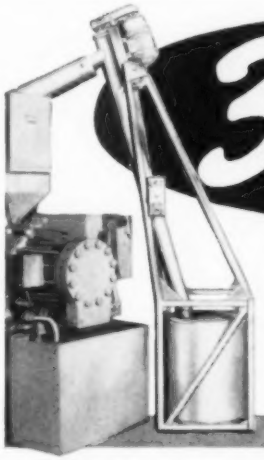

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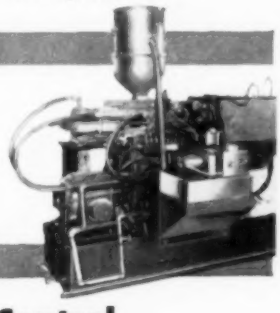

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Foster-Grant Co. To Expand

Foster Grant Company, Inc.—of Leominster, Massachusetts, and Baton Rouge, Louisiana—announced today through the office of its President, Joseph C. Foster, that they have acquired the services of three prominent plastics engineers. The company is building up its technical force in preparation for a determined bid to become a factor in the plastics raw materials picture.

As Director of Sales of the newly formed Petrochemical Division, the company confirms the appointment of John W. LaBelle, former New England District Sales Manager of the Chemical Division of the Koppers Co. During his association with the plastics industry he has held all offices of the Boston-Providence Chapter of the Society of the Plastics Industry and all offices of the Eastern New England Section of the Society of Plastics Engineers. At present he is National Director of the Eastern New England section and National Secretary of the Society.

As Director of Research of the Petrochemical Division, the company announces the appointment of Richard B. Bishop, a former specialist in research and development for the Socony Vacuum Oil Co. in Paulsboro, N. J. A former president and director of the Philadelphia Plastic Forum and a former president and treasurer of the Philadelphia Section of the Society of Plastics Engineers, Bishop served also as a National Director and National Treasurer of the Society. At present he is National Director of the Philadelphia Section and National Chairman of the Credentials Committee.

Mr. George Kovach, a chemical engineering graduate of Technische Hochschule, Vienna, Austria, is brought into the Foster Grant Company as Product Development Manager. At Clopay Corp. of Cincinnati, Ohio, he was Manager of the Plastics Division, where he started Clopay in the extrusion of vinyl film, vinyl sheeting, and rigid vinyl pipe. He is a member of the American Chemical Society, Society of the Plastics Industry, and Society of Plastics Engineers.

George Kovach

SPE 10th CONFERENCE
JAN. 27-28-29 TORONTO

PLASTICS AROUND THE WORLD

(continued from page 28)

Exhibition as pertaining to plastics.

GLASS - BONDED MICA INSULATION—by A. E. A. Wright

A two page article with tables gives test figures for electrical, mechanical, and thermal properties for compression molded and injection molded forms of glass-bonded mica. In addition, the industrial application of each type is examined.

IMPROVING THE QUALITY AND EFFICIENCY OF PLASTICS MOLDING II—by W. M. Halliday

A three page article discusses the third recommendation made by the Anglo-American Productivity Team. This report, which is one of 14 made by the team to develop greater efficiency in management, worker relations, product design and tooling, and actual molding production operations, covers the improvement of the general standard of efficiency by the greater interchange of factory visits within the industry, with emphasis on a real exchange of ideas at all levels.

Southern California Learns About Ductile Iron Tooling Problems

AUSTIN HERBST

At the September meeting of the So. Calif. Section, Dr. Morris Asimow, President, Enterprise Ductile Iron Foundry, Los Angeles, presented a very interesting and enlightening talk on "Ductile Iron Tooling in the Plastics Industry." Dr. Asimow is well qualified to discuss this interesting subject having formerly been in charge of the research laboratories at U. S. Steel Co.'s Gary Works.

Ductile iron was described as a new and revolutionary tool material which can be cast closely to contour for matched metal tooling with the result that substantial machining operations can be eliminated. It also has a fine grain structure, thereby permitting a high polish. Ductile iron has high mechanical strength and excellent hardenability. Specified areas and edges can be readily flame hardened so that the flash from a polyester-glass reinforced molding can be removed during the press cycle.

The 105 members and guests in attendance was an indication of the keen interest in this subject.

As an added attraction a diversified collection of metalized plastics, including both decorative as well as electronic applications, was exhibited through the courtesy of Silver Plastics Co., El Segundo, Calif.

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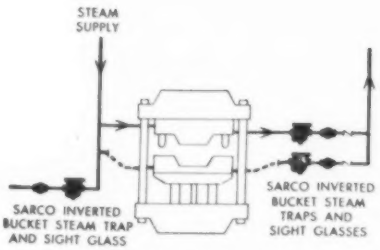
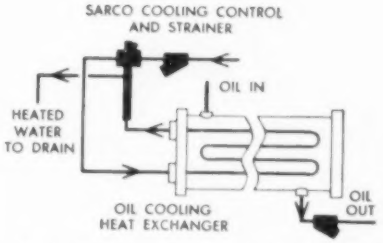
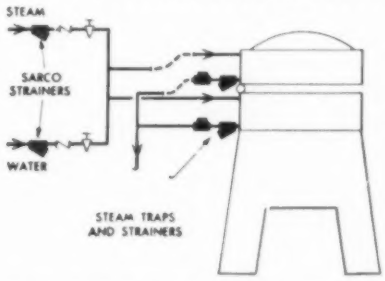


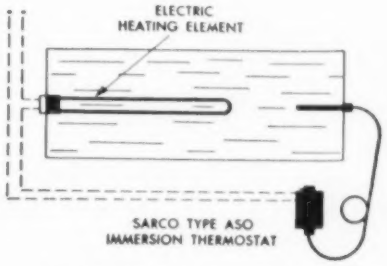
Compression molding press fitted with Sarco Inverted Bucket Steam Traps, the blast discharge of which scours the heating surface of the platens.



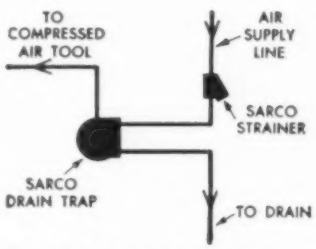
Heat exchanger cools hydraulic oil of plastics molding machines. Temperature of the cooling water is regulated by the Sarco Cooling Control.



Sarco steam traps on a steam-heated and water-cooled molding press.



Annealing bath temperature controlled by Sarco type ASO electric immersion thermostat.



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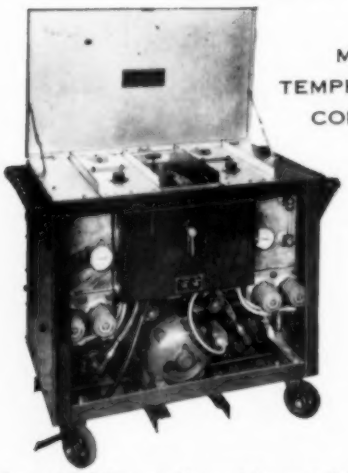

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Dear Friends:

Last month, we commented that it was nice to have you call and say "we have a tough job and want you folks to design the mold." Well, that is all well and good but let me point out that usually only one man can work on a specific design. When all the jobs are tough and take from 40 to 100 hours each, that means from 1 to 3 weeks actual designing time should be allowed. Of course, you should also allow us at least a week to get started because we are not exactly waiting for the next job to come in the door.

Speaking of letters (and no one was), we received one from Al Cole of A. E. Cole Die and Engraving Co., Columbus, Ohio. The last paragraph reads: "I ALSO WANT TO THANK YOU BOYS FOR THE SPEEDY SERVICE YOU GAVE US ON THIS MOLD." Thanks, Al, you don't know how hard we try for this every time on every job.

Yours for better living with Plastics

Wayne I. Pribble